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HEALTH AND SAFETY PLAN FOR PROJECT OPERATIONS SITE INVESTIGATION AND REMEDIAL INVESTIGATIONS VOLUME II OF II NTC ORLANDO FL

7/1/1994

ABB ENVIRONMENTAL SERVICES, INC

HEALTH AND SAFETY PLAN

PROJECT OPERATIONS PLAN FOR SITE INVESTIGATIONS AND REMEDIAL INVESTIGATIONS

VOLUME II OF II

NAVAL TRAINING CENTER ORLANDO
ORLANDO, FLORIDA

Unit Identification Code (UIC): N65928

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
BRAC	Base Realignment and Closure
CFR	Code of Federal Regulations
CHRIS	Chemical Hazards Response Information System
CLEAN	Comprehensive Long-term Environmental Activity, Navy
CPR	cardiopulmonary resuscitation
CRL	Certified Reporting Limit
CRZ	Contamination Reduction Zone
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization and Marketing Office
EBS	Environmental Baseline Survey
ECBSOPQAM	Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual
FID	flame ionization detector
FOL	Field Operations Leader
GM	Geiger Mueller
HASP	Health and Safety Plan
HNu	HNu, Inc., Manufacturer of Photoionization Detector
HSM	Health and Safety Manager
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
IAS	Initial Assessment Study
IDLH	Immediately Dangerous to Life and Health
LEL	lower explosive limit
MSA	
msl	mean sea level
NTC	Naval Training Center
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PID	photoionization detector
POI	point of interest
ppb	part per billion

GLOSSARY (Continued)

SOP	Standard Operating Procedure
TIP	total ionizables present
TLD	Thermoluminescent Dosimetry
TOM	Task Order Manager
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
UXO	Unexploded Ordnance
WWTP	Wastewater treatment plant

1.0 GENERAL

1.1 SCOPE AND PURPOSE. This Health and Safety Plan (HASP) has been prepared in conformance with the ABB Environmental Services, Inc. (ABB-ES), Health and Safety Program and the Comprehensive Long-Term Environmental Action, Navy (CLEAN) District I Contract (CLEAN HASP) and is intended to meet the requirements of 29 Code of Federal Regulation (CFR), Part 1910.120. As such, the HASP addresses those activities associated with field operations for this project. Compliance with this HASP is required for all ABB-ES personnel, contractor personnel, or third parties entering any site at Naval Training Center (NTC), Orlando.

The NTC, Orlando HASP contains some site-specific information, ABB-ES standard operating procedures and health and safety guidance included as Attachment A. A copy of this reference HASP will be available at each work location. Task-specific HASPs will be generated that describe the activities, potential hazards, precautions, and action levels associated with each task performed at NTC, Orlando.

1.2 PERSONNEL

1.2.1 Contractor Task Order Manager The contractor Task Order Manager (TOM) for Base Realignment and Closure (BRAC) activities at NTC, Orlando is Mr. James Manning. The TOM is the individual with overall project management responsibilities. Those responsibilities as they relate to health and safety include provision for the development of this site-specific HASP, the necessary resources to meet requirements of this HASP, the coordination of staff assignments to ensure that personnel assigned to the project meet medical and training requirements, and the means and materials necessary to resolve any health and safety issues that are identified or that develop on the project.

1.2.2 Health and Safety Manager The Health and Safety Manager (HSM) for ABB-ES, Ms. Cynthia Sundquist, may be reached at (207) 775-5401, extension 3309, in Portland, Maine. The HSM will be responsible for: (1) approval of the individual chosen to serve as the site Health and Safety Officer (HSO) for this field operation; (2) review and approval of the site HASP developed by the HSO, as well as any significant changes made over time to the site HASP; (3) oversight of the daily efforts of the HSO; (4) resolution of site disputes involving health and safety issues; and (5) implementation of the HASP by the HSO.

1.2.3 Health And Safety Supervisor (HSS) The HSS is the health and safety professional serving as the ABB-ES HSM's designee for this project. As such, the HSS will be responsible for (1) approval of the individual chosen to serve as the site HSO for this field operation; (2) review and approval of site-specific HASPs developed by the HSO, as well as any significant changes made over time to the site HASP; (3) oversight of the daily efforts of the HSO; (4) resolution of site disputes involving health and safety issues; and (5) implementation of the HASP by the HSO. The HSS will notify the HSM of any Stop Work Orders issued by an HSO.

1.2.4 Field Operations Leader The Field Operations Leader (FOL) is either the TOM or the TOM's designee who is onsite and is vested with the authority by the

TOM to carry out day-to-day site operations, including interfacing with the NTC, Orlando HSO.

1.2.5 Health and Safety Officer The HSO for this project has been designated by the TOM with concurrence from the HSM. The HSO will have at least an indirect line of reporting to the HSM for the duration of his/her assignment as project HSO. The HSO is responsible for developing and implementing this site-specific HASP in accordance with the ABB-ES Health and Safety Program. The HSO will investigate all accidents, illnesses, and incidents occurring onsite. The HSO will also conduct safety briefings and site-specific training for onsite personnel. As necessary, the HSO will accompany all U.S. Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), or other governmental agency personnel visiting an ABB-ES site in response to health and safety issues. The HSO, in consultation with the HSM, is responsible for updating and modifying this HASP as site or environmental conditions change.

An individual must have a minimum number of days of field experience (for the appropriate levels of protection, i.e., D, C, and B) and be current in first aid (certification within the last 3 years) and cardiopulmonary resuscitation (CPR) (certification within the last year) training to be eligible for the position of HSO.

1.3 TRAINING. Training is defined under the ABB-ES Health and Safety Program, and all personnel entering potentially contaminated areas of this site must meet the requirements of 29 CFR 1910.120. Personnel without the required training **will not be permitted** in any area with potential for exposure to toxic substances or harmful physical agents (i.e., in the exclusion zone). Refer to Appendix A for further information.

1.4 MEDICAL SURVEILLANCE. All personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program outlined in the ABB-ES Health and Safety Program. Personnel who have not received medical clearance **will not be permitted** in any area with potential for exposure to toxic substances or harmful physical agents (i.e., in the exclusion zone). Refer to Appendix B for further information.

1.5 DOCUMENTATION. A daily health and safety log will be maintained by the HSO. This log will include, at a minimum, the following information: description of the field work being conducted, any changes in the operation, names of all personnel working at the site, types of air monitoring equipment being used and how calibrated, air monitoring results, level of personal protective equipment being worn, accidents and injuries, and descriptions of any unusual occurrences of physical complaints.

2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 SITE NAME, LOCATION, AND SIZE. NTC, Orlando (Figure 2-1) encompasses 2,072 acres in Orange County, Florida, and consists of four discrete facilities: the Main Base, McCoy Annex, Herndon Annex, and Area "C".

The Main Base occupies approximately 1,095 acres within the city limits of Orlando and is located approximately 3 miles east of Interstate 4 and less than 1 mile north of State Road 50. Operations at the Main Base include the Recruit Training Command, Service School Command, Naval Administrative Command, Nuclear Power School, and the Naval Hospital (C.C. Johnson, 1985).

The facilities that comprise the McCoy Annex occupy 877 acres outside of the Orlando city limits and are located 12 miles south of the Main Base and just west of the Orlando International Airport. The Annex serves as a housing and community support activity for NTC, Orlando (C.C. Johnson, 1985).

Area "C" occupies an area of 46 acres and is located 1 mile west of the main base off Maguire Boulevard, and serves as a supply center for NTC, Orlando (C.C. Johnson, 1985).

Herndon Annex occupies 54 acres and is situated 1.5 miles south of the Main Base, within the confines of the general aviation Herndon Public Airport. Herndon Annex provides research, design, development, testing, evaluation, procurement, fabrication, maintenance, and logistical support for naval training equipment and devices. Herndon Annex is comprised of a computer center, flight-training building, uniform-supply warehouse, and several office buildings (C.C. Johnson, 1985).

2.2 SITE HISTORY AND LAYOUT

Main Base. The facilities at the Main Base were owned and operated by the Army Air Corps from 1940 to 1947 as the Orlando Air Base. The U.S. Air Force took command of the facilities during 1947, at which point it became the Orlando Air Force Base. The Air Photographic and Charter Service was the most active facility on the base and was responsible for photographic development of U.S. Air Force movies and still photographs. The property was commissioned as the Naval Training Center in 1968 when the U.S. Air Force ceased operations at the facility (ABB-ES, 1994a).

The area of the Main Base varies in elevation from approximately 125 feet above mean sea level (msl) at the Recruit Training Command (C.C. Johnson, 1985) to approximately 91 feet above msl at Lake Baldwin. Surface water runoff from this area flows through small intermittent streams and the storm drainage system to Lake Susannah and Lake Baldwin, and eventually to the Little Econlockhatchee River. Both of these lakes are used for fishing and recreation and are Class III waters according to the State of Florida (ABB-ES, 1994a).

The Main Base occupies approximately 1,095 acres within the Orlando city limits and is comprised mainly of operational and training facilities. These facilities

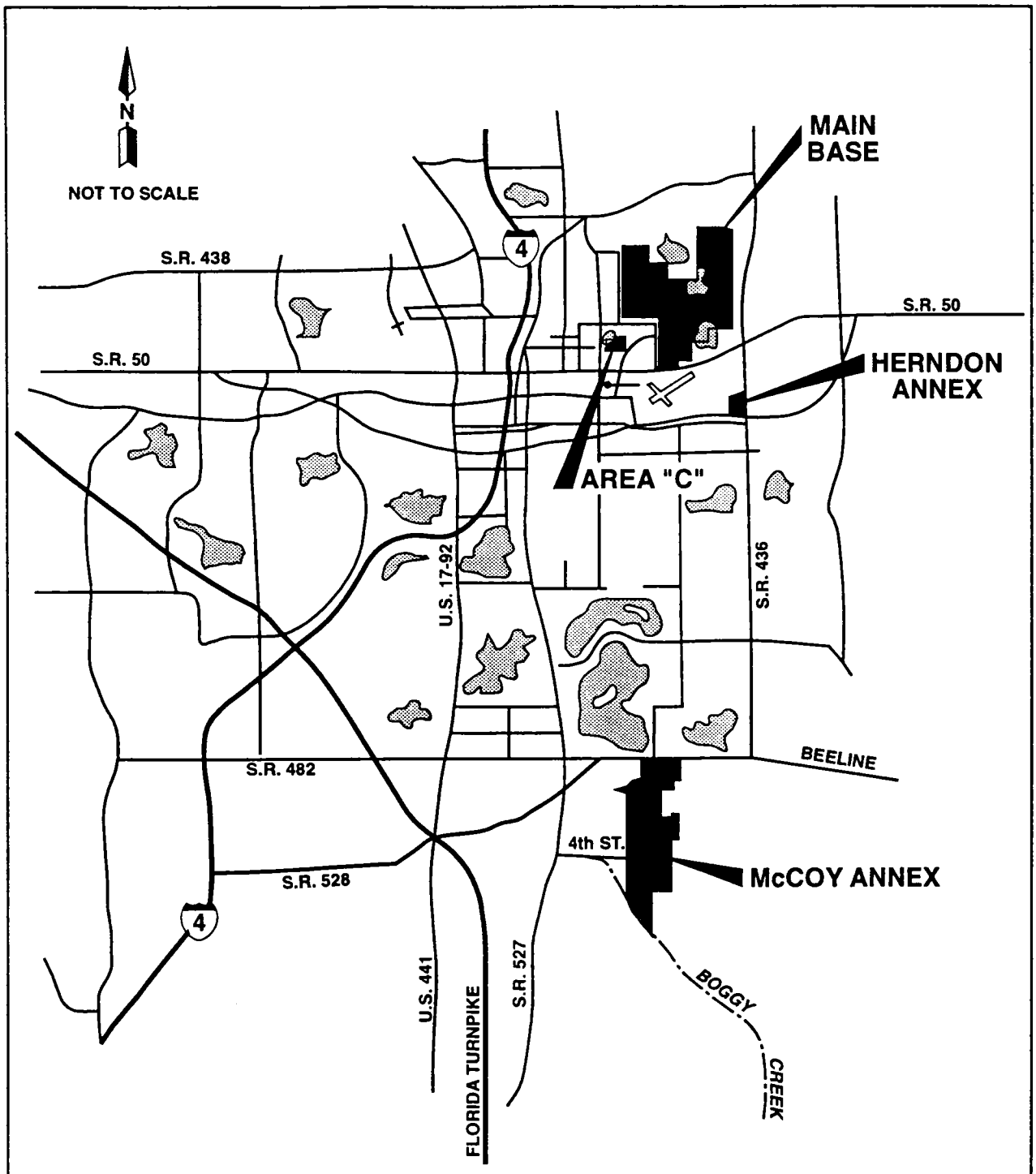

FIGURE 2-1

VICINITY MAP

PROJECT OPERATIONS PLAN, HEALTH AND SAFETY PLAN

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are used for training new recruits, and the land use is primarily barracks, training facilities, administrative buildings, drill fields, and recreational areas.

The area surrounding the Main Base is primarily residential with a commercially zoned area adjacent to the residential areas. There are two lakes within the Main Base property (Lakes Baldwin and Susannah) and four lakes (Spier, Forest, Shannon, and Gear) located in the residential areas adjacent to the facility (C.C. Johnson, 1985).

McCoy Annex. The McCoy Annex was originally owned and operated from 1950 to the late 1950's by the U.S. Air Force Strategic Air Command as the Pinecastle Air Force Base. It then became the McCoy Air Force Base from the late 1950's to 1974 when NTC, Orlando acquired the facility and renamed it the McCoy Annex (C.C. Johnson, 1985).

The land at McCoy Annex is essentially flat and gently sloping from north to south with little change in grade. The elevation is approximately 90 feet above msl and surface water flows south into the Boggy Creek Drainage Basin approximately 4 miles south of the Annex (C.C. Johnson, 1985). Surface water from Boggy Creek then flows into East Lake Tohopekaliga approximately 12.5 miles south of the Annex.

The McCoy Annex occupies 877 acres outside of the Orlando city limits and is located adjacent to Orlando International Airport on the east. There are two elementary schools located within a mile of the Annex on the west boundary and most of the area immediately adjacent to the Annex to the west is vacant wooded area. The Beeline Expressway forms the northern boundary. The property north of this expressway is used primarily for airport-related industry. Adjacent to the southern boundary are undeveloped woodlands. Land use at McCoy Annex is primarily housing and recreation (golf course) with limited operational facilities (C.C. Johnson, 1985).

Area "C". Area "C" was constructed in 1942 to provide support services for the Army Air Corps Orlando Air Base and consists of a laundry facility, supply storage, and the Defense Property Disposal Office (DPDO) facility. The laundry facility has been operated for military use since 1942. From 1942 to 1957, the supply storage warehouses and salvage yard received military supplies and salvageable material transported there by a railroad system. Since 1957, all materials have been shipped to Area "C" for storage via truck. In 1959, the DPDO took over operation of the salvage yard. The laundry facility, supply storage warehouses, and the DPDO have operated under the command of NTC, Orlando (ABB-ES, 1994a).

Area "C" is surrounded by urban development and multi-family residences to the north (with single family residences across Lake Druid), single family residences to the south and west, and an office park to the east. There are no industrial facilities in the vicinity of Area "C" (C.C. Johnson, 1985).

Herndon Annex. Herndon Annex borders a major residential area and is adjacent to the Herndon airport (C.C. Johnson, 1985). The Herndon Annex land surface slopes from a high of approximately 120 feet msl at the southwest corner to its low point of about 93 feet msl at the northeast corner adjacent to Lake Barton. Surface water runoff flows into Lake Barton or to a closed depression with a small sinkhole lake located on the east side of the area (USGS, 1980).

2.3 SCOPE OF WORK. Field investigations to be performed by ABB-ES will be designed to characterize soil, surface water, sediment, and groundwater conditions at the site. Tasks may include, but not be limited to, the following elements:

- geophysical surveys,
- test pit excavations,
- soil borings,
- monitoring well installations,
- soil gas sampling,
- soil and groundwater sampling,
- surface water and sediment sampling,
- water level measurements and aquifer tests,
- TerraProbe℠ investigations,
- Unexploded ordnance (UXO) clearance surveys, and
- seismic refraction surveys (information regarding the handling and use of explosives is provided in Appendix C).

2.4 SPECIFIC POINT OF INTEREST (POI) RISKS. ABB-ES has been tasked to conduct investigations at POIs identified in the Environmental Baseline Survey (EBS) of NTC, Orlando conducted by ABB-ES (1994b). The overall hazard level at NTC, Orlando is anticipated to be low. General health hazards and safety hazards associated with investigations at NTC, Orlando are presented in this section.

2.4.1 Health Hazards The potential health hazards associated with the POIs include inhalation, ingestion, and dermal contact of organic and inorganic chemicals that may be present in the subsurface soils and/or groundwater. Chemical Hazard Response Information System (CHRIS) data sheets for these compounds are presented in Chapter 3.0.

The primary hazards associated with several of the POIs are: gasoline or other fuel-related compounds, compounds including aliphatic and chlorinated solvents, pesticides, explosive chemicals, landfilled biological waste (information on blood borne pathogens is included in Appendix D), and radionuclides in the groundwater at the North Grinder and McCoy Annex landfills (information on ABB-ES' radiation protection program is included in Appendix E). Groundwater and surface water in the vicinity of the wastewater treatment plant and associated infiltration and sludge beds may contain coliform or nitrogen species at levels exceeding regulatory guidelines. In addition, during warm months (spring through early fall), tickborne Lyme Disease may be a potential health hazard in the NTC, Orlando region (information on Lyme Disease is included in Appendix F). Table 2-1 lists the expected wastes and probable contaminants of concern at NTC, Orlando identified during the Initial Assessment Study (IAS).

2.4.2 Safety Hazards Safety hazards include those typically encountered during operation of heavy equipment such as drilling rigs and backhoes and vibratory coring equipment. Special attention must be given by personnel working in the vicinity of this equipment to remain a safe distance from moving parts and tools. The subcontractors retained to operate this equipment will be solely responsible for the safety of their personnel. Clearance of underground and overhead utilities will be coordinated with the appropriate NTC, Orlando personnel. Additional underground clearance support will be available through geophysical survey results.

Table 2-1
Initial Assessment Study Points of Interest (POIs)

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IAS Site No.	POI Name	Period of Operation	Expected Waste Types	Estimated Quantities	Current Use
1	North Grinder Landfill	1958 to 1967	Film, photographic chemicals, paint thinner, perchloroethylene still bottoms, garbage from mess halls, cardboard boxes, biological wastes (syringes from hospital), paper, plastic, tree limbs, and construction materials.	194,000 cubic yards of waste, one-third of which was removed during dormitory construction.	Training operations, administrative functions, and housing.
2	Filled WWTP Lagoons	1977 to 1978	WWTP sludge, tree limbs, yard wastes, dirt, sand, asphalt, demolished building debris, and stainless-steel mixing tank.	Unknown	None
3	McCoy Annex Landfill	1960 to 1978	Paint, paint thinner, asbestos, transformers (possibly with transformer oil containing PCBs), hospital wastes (syringes, dressings, blood, and urine), radioactive waste, automobile batteries, steel cable, airplane parts, brick, fire hoses, parachutes, trees leaves, paper, plastic, scrap wood, scrap metal, sections of pipe, and waste oil.	>1,000,000 cubic yards of waste	Golf course
4	Disposal Area Near the Main Base Magazine No. 123	1968 to 1969	Yard wastes (tree limbs, and grass clippings).	Site was a pit 30 feet in diameter and 8 or 9 feet deep.	None
5	Old Laundry Boiler Building	? to 1972	Asbestos containing materials.	Unknown	Demolished in 1979; building was used to house boilers for the laboratory.
6	McCoy Annex DRMO	1984 to present	Used motor oil, antifreeze, hydraulic fluid (containing PCBs), and Soilax Liquid 'S' Plus Multipurpose Cleaner (containing NaOH and 2-butoxy ethanol).	1,000-4,000 gallons estimated to have been spilled.	Drum and transformer storage.

See notes at end of table.

Table 2-1 (Continued)
Initial Assessment Study Points of Interest (POIs)

Health and Safety Plan
NTC, Orlando
Orlando, Florida

IAS Site No.	POI Name	Period of Operation	Expected Waste Types	Estimated Quantities	Current Use
7	Barracks Burial Area	1968	Building debris	Unknown	Barracks were demolished and bulldozed into a quarry at the southwestern end of McCoy Annex.
8	Old Pesticide Storage Area	Early 1950's to 1972	Chlordane, phenyl mercuric compounds, baygon, diazinon, anticoagulant, malathion, pyrethrum, diron, 2,4-D, monuron, dieldrin, paraquat, kepone, endothall, naled, mineral oils, arsenic, dchlorvos, hydrothol, and dimethoate.	At least 300 gallons were buried when the building was demolished; ~62,000 gallons and ~46,000 pounds of pesticides were used per year (based on 1970 data).	Grassy area on perimeter of golf course (building was demolished in 1981).
9	Lake Baldwin	Early 1950's to 1978	Drainage from building 2089 of film, photographic developers, fixers, and activators.	Unknown	Recreational fishing, boating, and swimming by Navy personnel and the public.
10	McCoy Annex WWTP	Unknown	Iron, manganese, sulfate, nitrate, arsenic, and zinc	Unknown	Demolished

Source: Hazard Ranking System II (ABB-ES, 1992) and Initial Assessment Study (IAS) (C.C. Johnson, 1985).

Notes: POI = point of interest.
WWTP = wastewater treatment plant.
PCBs = polychlorinated biphenyls.
DRMO = Defense Reutilization and Marketing Office.
NaOH = sodium hydroxide.
2,4-D = 2,4-dichlorophenoxyacetic acid.

UXO may potentially be of concern at some of the POIs. If this is the situation, a qualified contractor will first clear the areas prior to commencing subsequent tasks at POIs where UXO is a concern. Appendix G details the basic methodologies, concepts, and considerations that will be incorporated during the activities at these sites.

Safety hazards exist when working on boats or floating platforms; all persons will have the ability to swim and will wear personal floatation devices when working on boats or floating platforms.

The primary safety hazards associated with any intrusive work (test-pitting and drilling) at the North Grinder and McCoy Annex landfills includes exposure to sharp medical wastes (syringes and broken glass), asbestos, transformer oil containing polychlorinated biphenyls (PCBs), and radioactive waste.

2.4.3 Specific POI Risks

2.4.3.1 Site 1, North Grinder Landfill The North Grinder Landfill (Site 1) was located in the northwest corner of the Main Base and covered approximately 15 acres. Buildings used for training operations, administrative functions, and housing surround Site 1 (ABB-ES, 1992). The wastes reportedly disposed in the landfill include film, photographic chemicals, paint thinner, garbage from mess halls, cardboard boxes, biological wastes and syringes from the hospital, paper, plastic, tree limbs, and construction materials. A summary of disposal history for the North Grinder Landfill and other sites is provided in Table 2-1. Reportedly, there were no known 55 gallons drums disposed in the landfill. It is estimated that the quantity of waste disposed in the landfill was 194,000 cubic yards, approximately 1/3 of which was removed during construction of Buildings 212 and 214 (C.C. Johnson, 1985).

Four shallow monitoring wells were installed at the site and analyses of samples collected from these wells indicated the presence of elevated levels of iron, arsenic, zinc, manganese, methylene chloride, phenols, and radionuclides (Geraghty & Miller, 1986).

2.4.3.2 Site 3, McCoy Annex Landfill The McCoy Annex Landfill is located in the southern part of the McCoy Annex. The landfill is currently a nine hole golf course, and is surrounded by residential areas on the north, NTC, Orlando facilities on the east, and wooded areas on the west and south (ABB-ES, 1992).

The wastes disposed in the landfill were reportedly paint, paint thinner, asbestos, transformers (possibly with transformer oil containing PCBs), autoclaved hospital wastes (including syringes, dressings, blood, and urine), radioactive waste, automobile batteries, steel cable, airplane parts, brick, fire hoses, parachutes, trees, leaves, paper, plastic, scrap wood, scrap metal, sections of pipe, and possibly waste oil. A summary of the disposal history for the McCoy Annex Landfill and other sites is provided in Table 2-1. It is unknown if the transformers and batteries were drained. The golf course was constructed over the landfill area during 1981 (C.C. Johnson, 1985).

Geraghty & Miller (1986) reported that the monitoring wells installed during the Verification Study should have encountered any constituents moving with the groundwater. Analyses of groundwater samples indicate elevated levels of iron

(9,800 parts per billion [ppb]), arsenic (20 ppb), zinc (40 ppb), radionuclides, and manganese. Benzene (31 ppb), chlorobenzene (36 ppb), ethylbenzene (10 ppb), 1,4-dichlorobenzene (8.3 ppb), and naphthalene (16 ppb) were also detected. Contaminants detected in surface water samples collected along the drainage canals included phenols (3,400 ppb), methylene chloride (6.7 ppb), and lead (12 ppb). Arsenic was detected in the sediments from one sampling area at 53 ppb (Geraghty & Miller, 1986). The Hazard Ranking System II reported that analyses of leachate samples indicated the presence of mercury; however, no data from the Verification Study were available to support this claim (ABB-ES, 1992).

2.4.3.3 Site 6, McCoy Annex Defense Reutilization and Marketing Office (DRMO) The McCoy Annex DRMO is located in the southeastern section of the McCoy Annex and is surrounded by Building 7193 on the north, Building 7191 on the southeast, Ammons Avenue on the southwest, and Building 72312 on the west (ABB-ES, 1992).

The McCoy Annex DRMO was used for storage of 73 55-gallon drums containing chemical waste since at least 1984. During the IAS, it was noted that these drums were in various stages of deterioration and at least one was completely corroded. Few labels or markings were observed on the drums, but they were reported to have contained used motor oil, antifreeze, and hydraulic fluid (possibly containing PCBs). One drum was marked "Soilax Liquid 'S' Plus, Multipurpose Cleaner", which contains sodium hydroxide and 2-butoxy ethanol. Another drum was marked "Paint Thinning Liquid." A summary of disposal history for the McCoy Annex DRMO and other sites is provided in Table 2-1.

Groundwater samples collected by Geraghty & Miller (1986) during the Verification Study at this site were analyzed and reported to contain trace amounts of methylene chloride (9.6 ppb), copper (50 ppb), lead (14 ppb), and zinc (610 ppb). In addition, the Verification Study identified elevated concentrations of iron (9,800 ppb), radionuclides, manganese (1,300 ppb), benzene (31 ppb), chlorobenzene (36 ppb), ethylbenzene (10 ppb), 1,4-dichlorobenzene (8.3 ppb), and naphthalene (16 ppb); however, no laboratory data exist in the Verification Study report to support these findings. No detectable priority pollutants were found in soil composite samples from the site except for mercury (1.2 ppb) and trace methylene chloride (Geraghty & Miller, 1986).

2.4.3.4 Site 8, Old Pesticide Storage Building The Old Pesticide Storage Building was located in the southeast corner of the Main Base adjacent to Trident Lane before it was demolished in 1981. The building was located on the edge of the golf course and was surrounded on the northwest by Lake Baldwin, on the west by residential areas, and on the south and east by the golf course (ABB-ES, 1992).

Pesticides reported to have been used at the facility include chlordane, phenyl mercuric compounds, baygon, diazinon, anticoagulant, malathion, pyrethrum, diron, 2,4-dichlorophenoxyacetic acid (2,4-D), and monuron (C.C. Johnson, 1985). Analyses of groundwater samples collected during the Verification Study indicated trace levels of bis(2-ethylhexyl)phthalate (6 ppb), ethylbenzene (13 ppb), phenol (7 ppb), 2-chlorophenol (7 ppb), 2,4-dichlorophenol (33 ppb), chlordane (7 ppb), naphthalene (26 ppb), and zinc (30 ppb) (C.C. Johnson, 1985). A summary of disposal history for the Old Pesticide Storage Building and other sites is provided in Table 2-1.

2.4.3.5 **Site 9, Lake Baldwin** Lake Baldwin, also referred to as Lake Corrine, is located in the central to northeast part of the Main Base, and is surrounded by NTC, Orlando facilities, the Naval Hospital, and a recreation area (ABB-ES, 1992).

Film and photographic development chemicals were drained from Building 2089 through a storm sewer and onto the southwest shore of Lake Baldwin from the early 1950's to 1978. The chemicals discharged included photographic developers, fixers, and activators (C.C. Johnson, 1985). A summary of disposal history for Lake Baldwin and other sites is provided in Table 2-1. Surface water sampling results indicate that alpha-BHC occurs at levels of 0.1 ppb.

2.4.3.6 **Site 10, McCoy Annex Wastewater Treatment Plant (WWTP)** The McCoy Annex WWTP is no longer present at the site, but the area where it was located is north of Site 3, directly across 8th Street. The site is surrounded on the remaining three sides by wooded areas (ABB-ES, 1992).

No information was found for this site to determine the years of operation, potential contamination, or other historical data. Limited information of disposal history for the McCoy Annex WWTP and other sites is provided in Table 2-1. During the Verification Study, two shallow monitoring wells were installed at the site, and analyses of the samples indicated the presence of iron (4,800 ppb), manganese (170 ppb), sulfate (340,000 ppb), nitrate (32,000 ppb), arsenic (25 ppb), and zinc (70 ppb) (Geraghty & Miller, 1985).

2.4.4 Levels of Protection Information regarding the levels of protection that will be used during this field investigation are listed below:

- geophysical survey, Level D;
- test pit excavation and sampling, Modified Level D, or Level B if the information available is insufficient to identify the hazards;
- boring and subsurface soil sampling, Modified Level D;
- monitoring well installation and sampling, Modified Level D; and
- surface water and sediment sampling, ecological sampling, water level measurement, and aquifer testing, Level D.

Descriptions of each protective ensemble (i.e., Level A, Level B, etc.) are provided in Appendix H.

Modified Level D protection is anticipated to be sufficient for a majority of the exploratory and sampling work to be conducted at the installation. Rarely are breathing zone levels of contaminants expected to increase to the point where respiratory protection is required; however, a photoionization detector (PID) or flame ionization detector (FID) and Draeger tubes will be in use at each exploratory location to monitor the breathing zone.

2.4.5 Monitoring The work environment will be monitored to ensure that Immediately Dangerous to Life and Health (IDLH) or other dangerous conditions are identified. At a minimum, monitoring will include evaluations for combustible

atmospheres, oxygen-deficient environments, and hazardous concentrations of airborne contaminants. The combustible gas meter, set to alarm at 10 percent of the lower explosive limit (LEL), will be continuously used.

2.4.6 Air Sampling To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading the levels of protection in conformance with action levels provided in this HASP and at the direction of the task HSO.

The following sampling equipment will be used at the site:

1. ISD dual detector (O_2/LEL),
2. HNU™ IS101 and Photovac total ionizables present (TIP™) photoionization detectors,
3. detector tubes (MSA and Draeger)
4. FID, and
5. radiation detector (i.e., pancake Geiger Mueller [GM] detector or gamma scintillation detector).

Refer to Appendix I for information on the calibration and maintenance of the equipment.

2.4.7 Personal Monitoring

Thermoluminescent Dosimetry (TLD) Body Badges. These devices are nonmechanical collection devices used to monitor for x-ray, beta, and gamma radiation exposure. They are worn by ABB-ES associates and sent to Landauer, Inc., for analysis on a quarterly basis.

Note: It is ABB-ES's policy that every associate wear dosimeters while on military installations.

Personal monitoring may be warranted if there is a potential of exposure to a substance that has a specific substance OSHA standard (i.e., asbestos 29CFR1910.1001), or to characterize the personal exposure of high-risk employees to the hazardous substances that they may encounter onsite.

2.4.8 Hearing Protection All personnel exposed to noise levels in excess of 85 decibels will be required to wear hearing protection.

3.0 CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM (CHRIS) DATA SHEETS

These sheets were originally authored and assembled by the U.S. Department of Transportation (USDOT) and U.S. Coast Guard (USCG) for over-land and over-sea transportation information and guidelines, and are provided in this HASP to disseminate information needed for decision-making personnel during the transport and handling of chemicals. In addition, these sheets should be used to achieve better safety procedures and to prevent accidents.

CHRIS data sheets have been included for the following compounds: arsenic, methylene chloride, phenol, mercury, benzene, chlorobenzene, ethylbenzene, tetrachloroethylene (perchloroethylene), 2-chlorophenol, 2,4-dichlorophenol, chlordane, naphthalene, diazinon, 2,4 - D, dichlorvos, dieldrin, diuron, kepone, malathion, naled, mineral oil, motor oil, transformer oil, pyrethrins, and turpentine (paint thinner).

ARSENIC

ARX

Common Synonyms	Solid crystals	Gray
Arsenic, solid Arsenic, metallic Gray arsenic	Sinks in water.	

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear self-contained positive pressure breathing apparatus and full protective clothing.
Stay upwind and use water spray to "knock down" dust.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Can be heated to burn in air.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear self-contained positive pressure breathing apparatus and full protective clothing.
Extinguish small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam.

Exposure

CALL FOR MEDICAL AID.

DUST
POISONOUS IF INHALED.
Move victim to fresh air.
IF IN EYES OR ON SKIN, immediately flush with running water for at least 15 minutes; hold eyelids open if necessary.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED.
IF IN EYES OR ON SKIN, flush with running water for at least 15 minutes; hold eyelids open if necessary.
IF SWALLOWED and victim is CONSCIOUS and has not vomited, induce vomiting with syrup of ipecac.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effects of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning - poison.
Restrict access.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** As
3.3 **IMO/UN Designation:** 6.1/1558
3.4 **DOT ID No.:** 1558
3.5 **CAS Registry No.:** 7440-38-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** Silver-gray
4.3 **Odor:** Data not available

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Wear self-contained positive pressure breathing apparatus and full protective clothing.
5.2 **Symptoms Following Exposure:** Poisonous by inhalation of dust or by ingestion. Regardless of exposure route, symptoms in most cases are characteristic of severe gastritis or gastroenteritis. All chemical forms of arsenic eventually produce similar toxic effects. Symptoms may be delayed.
5.3 **Treatment of Exposure:** Get medical attention after any exposure to this metal. INHALATION: Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. EYES OR SKIN: Immediately flush with running water for at least 15 minutes; hold eyelids open if appropriate. Use soap and water to clean skin. Remove and isolate contaminated clothing and shoes. INGESTION: If the victim is alert and has not vomited, induce vomiting with syrup of ipecac.
5.4 **Threshold Limit Value:** 0.2 mg/m³
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Data not available
5.7 **Late Toxicity:** Human carcinogen. Causes mutagenic, reproductive and tumorigenic effects along with damage to the gastrointestinal tract and degeneration of the liver and kidneys.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** Not pertinent
6.2 **Flammable Limits in Air:** Not pertinent
6.3 **Fire Extinguishing Agents:** Small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Contain highly toxic arsenic trioxide and other forms of arsenic. Arsenic gas, the most dangerous form of arsenic, is produced upon contact with an acid or acid fumes.
6.6 **Behavior in Fire:** Burns to produce dense white fumes of highly toxic arsenic trioxide.
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Incompatible with zinc.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** Bioaccumulated by fresh water and marine aquatic organisms.

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Crude, 90-95%; Refined, 99%; Semiconductor, 99.999%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** Not listed
9.4 **Venting:** Not pertinent

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison: B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 74.9216
12.3 **Boiling Point at 1 atm:** 1,135°F = 613°C = 886°K (sublimes)
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** 1477.4°F = 803°C = 1076.2°K
12.6 **Critical Pressure:** 5027.4 psia = 342.0 atm = 34.6 MN/m²
12.7 **Specific Gravity:** 5.727 at 25°C (solid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

6. FIRE HAZARDS (Continued)

6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

ARSENIC

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

PHENOL

PHN

Common Synonyms	Solid crystals; or watery liquid	White solid, or light pink liquid	Sweet tarry odor
Hydroxybenzene Carbolic acid Phenic acid Phenyl hydroxide	May float or sink, and mixes slowly with water.		

AVOID CONTACT WITH LIQUID AND SOLID. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible. Call fire department.
Evacuate area in case of large discharge.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with water, carbon dioxide, dry chemical, or foam.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID OR SOLID
POISONOUS IF SWALLOWED.
Will burn skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Phenol, cresol
3.2 **Formula:** C_6H_5OH
3.3 **IMO/UN Designation:** 9.0/1671
3.4 **DOT ID No.:** 1671
3.5 **CAS Registry No.:** 108-95-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid or molten liquid
4.2 **Color:** Colorless to light pink
4.3 **Odor:** Characteristically sweet; sweet, tarry; pungent, distinctive; distinct, aromatic, somewhat sickening sweet and acrid

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Fresh-air mask for confined areas; rubber gloves; protective clothing; full face shield.
5.2 **Symptoms Following Exposure:** Will burn eyes and skin. The analgesic action may cause loss of pain sensation. Readily absorbed through skin, causing increase in heart rate, convulsions, and death.
5.3 **Treatment of Exposure:** INHALATION: if victim shows any ill effects, move him to fresh air, keep him quiet and warm, and call a doctor immediately; if breathing stops, give artificial respiration. INGESTION: do NOT induce vomiting; give milk, egg whites, or large amounts of water and call doctor immediately; no known antidote; treat the symptoms. EYES: immediately flush with plenty of water for at least 15 min.; continue for another 15 min. if doctor has not taken over. SKIN: immediately remove all clothing while in a shower and wash affected area with abundant flowing water or soap and water for at least 15 min.; clean clothing thoroughly or discard.
5.4 **Threshold Limit Value:** 5 ppm (includes skin exposure).
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** Carcinogenic in laboratory animals
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact.
5.10 **Odor Threshold:** 0.05 ppm
5.11 **IDLH Value:** 100 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 185°F O.C.; 175°F C.C.
6.2 **Flammable Limits in Air:** 1.7%-8.6%
6.3 **Fire Extinguishing Agents:** Water fog, foam, carbon dioxide, or dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic and irritating vapors are generated when heated.
6.6 **Behavior in Fire:** Yields flammable vapors when heated which will form explosive mixtures with air.
6.7 **Ignition Temperature:** 1319°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 3.5 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 21

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 11.5-28.5 mg/l/96 hr/bluegill/TL_m/fresh water
1.5 ppm/48 hr/rainbow trout/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 200%, 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 90-99% (solid), 80-85% (liquid). Technical: 82-92% (contains cresols)
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, B
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	3
Poisons	3
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	3
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid or liquid
12.2 **Molecular Weight:** 94.11
12.3 **Boiling Point at 1 atm:** 359.2°F = 181.8°C = 456.0°K
12.4 **Freezing Point:** 105.6°F = 40.9°C = 314.1°K
12.5 **Critical Temperature:** 790.0°F = 421.1°C = 694.3°K
12.6 **Critical Pressure:** 889 psia = 60.5 atm = 6.13 MN/m²
12.7 **Specific Gravity:** 1.056 at 41°C (liquid)
12.8 **Liquid Surface Tension:** 36.5 dynes/cm = 0.0365 N/m at 55°C
12.9 **Liquid Water Interfacial Tension:** (est.) 20 dynes/cm = 0.02 N/m at 42°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.089
12.12 **Latent Heat of Vaporization:** 130 Btu/lb = 72 cal/g = 3.0 X 10^5 J/kg
12.13 **Heat of Combustion:** —13,400 Btu/lb = —7,445 cal/g = —311.7 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.3 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

PHN	PHENOL

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
110	65.870
115	65.719
120	65.559
125	65.410
130	65.250
135	65.099
140	64.940
145	64.790
150	64.629
155	64.469
160	64.309
165	64.160
170	64.000
175	63.840
180	63.670
185	63.510
190	63.350
195	63.190
200	63.020
205	62.860
210	62.690

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
108	.561
109	.561
110	.561
111	.561
112	.561
113	.561
114	.561
115	.561
116	.561
117	.561
118	.561
119	.561
120	.561
121	.561
122	.561
123	.561
124	.561
125	.561
126	.561
127	.561
128	.561
129	.561
130	.561
131	.561
132	.561
133	.561

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
122.02	1.113

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
110	4.302
115	3.929
120	3.594
125	3.292
130	3.021
135	2.775
140	2.554
145	2.353
150	2.171
155	2.005
160	1.855
165	1.718
170	1.593
175	1.479

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	8.400

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
70	.012
80	.017
90	.024
100	.034
110	.048
120	.066
130	.091
140	.123
150	.165
160	.220
170	.289
180	.378
190	.490
200	.629
210	.802
220	1.016
230	1.278
240	1.596
250	1.982
260	2.446
270	3.002
280	3.663
290	4.446
300	5.370
310	6.453
320	7.718

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
70	.00019
80	.00027
90	.00039
100	.00054
110	.00074
120	.00100
130	.00135
140	.00180
150	.00238
160	.00311
170	.00403
180	.00518
190	.00661
200	.00836
210	.01050
220	.01311
230	.01624
240	.02000
250	.02449
260	.02980
270	.03607
280	.04342
290	.05200
300	.06197
310	.07350
320	.08679

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.224
25	.237
50	.250
75	.262
100	.274
125	.286
150	.297
175	.309
200	.319
225	.330
250	.341
275	.351
300	.360
325	.370
350	.379
375	.388
400	.397
425	.405
450	.414
475	.422
500	.429
525	.436
550	.444
575	.450
600	.457

MERCURY

MCR

Common Synonyms	Liquid	Silver	Odorless
Quicksilver	Sinks in water.		

AVOID CONTACT WITH LIQUID. Keep people away.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Effects of exposure may be delayed.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** Hg
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2809
3.5 **CAS Registry No.:** 7439-97-6

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Silvery
4.3 **Odor:** None

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Avoid contact of liquid with skin. For vapor use chemical cartridge (Hopcalite) respirator.
5.2 **Symptoms Following Exposure:** No immediate symptoms. As poisoning becomes established, slight muscular tremor, loss of appetite, nausea, and diarrhea are observed. Psychic, kidney, and cardiovascular disturbances may occur.
5.3 **Treatment of Exposure:** Consult a doctor.
5.4 **Threshold Limit Value:** 0.05 mg/m^3
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** No immediate toxicity
5.7 **Late Toxicity:** Development of mercury poisoning
5.8 **Vapor (Gas) Irritant Characteristics:** None
5.9 **Liquid or Solid Irritant Characteristics:** None
5.10 **Odor Threshold:** Not pertinent
5.11 **IDLH Value:** 28 mg/m^3

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not flammable
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.5-1 ppm/48 hr/carassius ardium/TL_m/fresh water
0.29 ppm/48 hr/marine fish/TL_m/salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** Mercury concentrates in liver and kidneys of ducks and geese to levels above FDA limit of 0.5 ppm. Muscle tissue usually well below the limit.

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Pure
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 200.59
12.3 **Boiling Point at 1 atm:** 675°F = 357°C = 630°K
12.4 **Freezing Point:** −38.0°F = −38.9°C = 234.3°K
12.5 **Critical Temperature:** 2664°F = 1462°C = 1735°K
12.6 **Critical Pressure:** 23,300 psia = 1587 atm = 160.8 MN/m^2
12.7 **Specific Gravity:** 13.55 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 470 dynes/cm = 0.470 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 375 dynes/cm = 0.375 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 2.7 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

MERCURY

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
0	851.399
5	851.000
10	850.500
15	850.099
20	849.699
25	849.199
30	848.799
35	848.399
40	847.899
45	847.500
50	847.099
55	846.599
60	846.199
65	845.799
70	845.299
75	844.899
80	844.500
85	844.000
90	843.599
95	843.199
100	842.699

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.033
40	.033
45	.033
50	.033
55	.033
60	.033
65	.033
70	.033
75	.033
80	.033
85	.033
90	.033
95	.033
100	.033

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	1.827
5	1.801
10	1.777
15	1.754
20	1.731
25	1.709
30	1.688
35	1.668
40	1.648
45	1.629
50	1.610
55	1.592
60	1.575
65	1.558
70	1.541
75	1.525
80	1.510
85	1.495
90	1.480
95	1.466
100	1.452

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

BENZENE

BNZ

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Benzol Benzole	Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** C_6H_6
3.3 **IMO/UN Designation:** 3.2/1114
3.4 **DOT ID No.:** 1114
3.5 **CAS Registry No.:** 71-43-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Aromatic; rather pleasant aromatic odor; characteristic odor

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.
5.2 **Symptoms Following Exposure:** Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death.
5.3 **Treatment of Exposure:** SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 75 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Leukemia
5.8 **Vapor (Gas) Irritant Characteristics:** If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 4.68 ppm
5.11 **IDLH Value:** 2,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 12°F C.C.
6.2 **Flammable Limits in Air:** 1.3%-7.9%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back
6.7 **Ignition Temperature:** 1097°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 6.0 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/TL_m/tap water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 1.2 lb/lb, 10 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:**
Industrial pure .....99+%
Thiophene-free .....99+%
Nitration .....99+%
Industrial 90% .....85+%
Reagent ..... 99+%
9.2 **Storage Temperature:** Open
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 78.11
12.3 **Boiling Point at 1 atm:** 176°F = 80.1°C = 353.3°K
12.4 **Freezing Point:** 42.0°F = 5.5°C = 278.7°K
12.5 **Critical Temperature:** 552.0°F = 288.9°C = 562.1°K
12.6 **Critical Pressure:** 710 psa = 48.3 atm = 4.89 MN/m²
12.7 **Specific Gravity:** 0.879 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.9 dynes/cm = 0.0289 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 35.0 dynes/cm = 0.035 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 2.7
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.061
12.12 **Latent Heat of Vaporization:** 169 Btu/lb = 94.1 cal/g = 3.94 X 10^5 J/kg
12.13 **Heat of Combustion:** −17,460 Btu/lb = −9696 cal/g = −406.0 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 30.45 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 3.22 psia

NOTES

BNZ	BENZENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
55	55.330
60	55.140
65	54.960
70	54.770
75	54.580
80	54.400
85	54.210
90	54.030
95	53.840
100	53.660
105	53.470
110	53.290
115	53.100
120	52.920
125	52.730
130	52.540
135	52.360
140	52.170
145	51.990
150	51.800
155	51.620
160	51.430
165	51.250
170	51.060
175	50.870

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
45	.394
50	.396
55	.398
60	.400
65	.403
70	.405
75	.407
80	.409
85	.411
90	.414
95	.416
100	.418

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
75	.988
80	.981
85	.975
90	.969
95	.962
100	.956
105	.950
110	.944
115	.937
120	.931
125	.925
130	.919
135	.912
140	.906
145	.900
150	.893
155	.887
160	.881
165	.875
170	.868

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
55	.724
60	.693
65	.665
70	.638
75	.612
80	.588
85	.566
90	.544
95	.524
100	.505
105	.487
110	.470
115	.453
120	.438

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.180

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
50	.881
60	1.171
70	1.535
80	1.989
90	2.547
100	3.227
110	4.049
120	5.033
130	6.201
140	7.577
150	9.187
160	11.060
170	13.220
180	15.700
190	18.520
200	21.740
210	25.360

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
50	.01258
60	.01639
70	.02109
80	.02681
90	.03371
100	.04196
110	.05172
120	.06317
130	.07652
140	.09194
150	.10960
160	.12980
170	.15270
180	.17850
190	.20750
200	.23970
210	.27560

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.204
25	.219
50	.234
75	.248
100	.261
125	.275
150	.288
175	.301
200	.313
225	.325
250	.337
275	.349
300	.360
325	.371
350	.381
375	.392
400	.402
425	.412
450	.421
475	.431
500	.440
525	.449
550	.457
575	.465
600	.474

CHLOROBENZENE

CRB

Common Synonyms	Watery liquid	Colorless	Sweet, almond odor
Monochlorobenzene Phenyl chloride Benzene chloride MCB	Sinks in water. Flammable vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Stop discharge if possible.
Call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.

Exposure

CALL FOR MEDICAL AID.

VAPOR
If inhaled, will cause coughing or dizziness.
Not irritating to eyes, nose and throat.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** C_6H_5Cl
3.3 **IMO/UN Designation:** 3.3/1134
3.4 **DOT ID No.:** 1134
3.5 **CAS Registry No.:** 108-90-7

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Mild amine odor; sweet, almond-like; aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor-acid gas respirator where appropriate; neoprene or vinyl gloves; chemical safety spectacles, plus face shield where appropriate; rubber footwear; apron or impervious clothing for splash protection; hard hat.
5.2 **Symptoms Following Exposure:** Irritating to skin, eyes and mucous membranes. Repeated exposure of skin may cause dermatitis due to defatting action. Chronic inhalation of vapors or mist may result in damage to lungs, liver, and kidneys. Acute vapor exposures can cause symptoms ranging from coughing to transient anesthesia and central nervous system depression.
5.3 **Treatment of Exposure:** Get medical attention for all eye exposures and any serious over-exposures. Treat the symptoms. INHALATION: remove to clean air; administer oxygen as needed. INGESTION: dilute by drinking water; if vomiting occurs, administer more water. Administer saline laxative. EYES: flush thoroughly with water. SKIN: remove contaminated clothing, wash exposed area with soap and water.
5.4 **Threshold Limit Value:** 75 ppm
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat, rabbit)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors are nonirritating to the eyes and throat.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.21 ppm
5.11 **IDLH Value:** 2,400 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 84°F C.C., 97°F O.C.
6.2 **Flammable Limits in Air:** 1.3%-7.1%
6.3 **Fire Extinguishing Agents:** Carbon dioxide, dry chemical, foam or water spray
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Burning in open flame can form toxic phosgene and hydrogen chloride gases.
6.6 **Behavior in Fire:** Heavy vapor can travel a considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 1184°F
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** (est.) 4.6 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 20 ppm/96 hr/bluegill/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0.3 lb/lb, 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 99.5%; technical
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	0
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 112.56
12.3 **Boiling Point at 1 atm:** 270°F = 132°C = 405°K
12.4 **Freezing Point:** −50.1°F = −45.6°C = 227.6°K
12.5 **Critical Temperature:** 678°F = 359°C = 632°K
12.6 **Critical Pressure:** 656 psia = 44.6 atm = 4.52 MN/m²
12.7 **Specific Gravity:** 1.11 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 33 dynes/cm = 0.033 N/m at 25°C
12.9 **Liquid Water Interfacial Tension:** 37.41 dynes/cm = 0.03741 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.094
12.12 **Latent Heat of Vaporization:** 135 Btu/lb = 75 cal/g = 3.140×10^5 J/kg
12.13 **Heat of Combustion:** (est.) 12,000 Btu/lb = 6700 cal/g = 280×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 20.40 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.5 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

CRB

CHLOROBENZENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	70.419
40	70.230
45	70.040
50	69.849
55	69.660
60	69.469
65	69.270
70	69.080
75	68.889
80	68.700
85	68.500
90	68.309
95	68.120
100	67.919
105	67.730
110	67.530
115	67.339
120	67.139
125	66.950
130	66.750
135	66.559
140	66.360
145	66.169
150	65.969
155	65.770
160	65.580

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
40	.316
50	.317
60	.319
70	.321
80	.323
90	.325
100	.327
110	.329
120	.331
130	.333
140	.335
150	.337
160	.339
170	.341
180	.343
190	.345
200	.347
210	.349

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
−20	.956
−10	.946
0	.937
10	.927
20	.917
30	.908
40	.898
50	.888
60	.879
70	.869
80	.859
90	.850
100	.840
110	.830
120	.821
130	.811
140	.801
150	.792
160	.782
170	.772

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	1.027
40	.987
45	.949
50	.914
55	.880
60	.848
65	.818
70	.790
75	.763
80	.738
85	.713
90	.690
95	.668
100	.648
105	.628
110	.609
115	.591
120	.574
125	.558
130	.542
135	.527
140	.513
145	.499
150	.486
155	.473

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.049

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
20	.032
30	.048
40	.069
50	.099
60	.140
70	.195
80	.269
90	.366
100	.492
110	.656
120	.865
130	1.130
140	1.464
150	1.880
160	2.394
170	3.026
180	3.797
190	4.731
200	5.856
210	7.203

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
20	.00071
30	.00102
40	.00145
50	.00204
60	.00283
70	.00386
80	.00522
90	.00698
100	.00923
110	.01207
120	.01565
130	.02010
140	.02560
150	.03233
160	.04051
170	.05039
180	.06224
190	.07636
200	.09309
210	.11280

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.178
25	.188
50	.198
75	.207
100	.217
125	.226
150	.235
175	.244
200	.252
225	.261
250	.269
275	.277
300	.285
325	.292
350	.300
375	.307
400	.314
425	.320
450	.327
475	.333
500	.340
525	.345
550	.351
575	.357
600	.362

TETRACHLOROETHYLENE

TTE

Common Synonyms	Watery liquid	Colorless	Sweet odor
Tetracap Perclene Perchloroethylene Perk	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
Poisonous gases are produced when heated.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $Cl_2C=CCl_2$
3.3 IMO/UN Designation: 9.0/1897
3.4 DOT ID No.: 1897
3.5 CAS Registry No.: 127-18-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal; like chloroform; mildly sweet

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield; plastic gloves.
5.2 Symptoms Following Exposure: Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.
5.3 Treatment of Exposure: INHALATION: if illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 100 ppm for 60 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or throat if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 5 ppm
5.11 IDLH Value: 500 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic, irritating gases may be generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Dry cleaning and industrial grades: 95+ %
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	0
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	1

11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 165.83
12.3 Boiling Point at 1 atm: 250°F = 121°C = 394°K
12.4 Freezing Point: −8.3°F = −22.4°C = 250.8°K
12.5 Critical Temperature: 657°F = 347°C = 620°K
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.63 at 20°C (liquid)
12.8 Liquid Surface Tension: 31.3 dynes/cm = 0.0313 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 44.4 dynes/cm = 0.0444 N/m at 25°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.116
12.12 Latent Heat of Vaporization: 90.2 Btu/lb = 50.1 cal/g = 2.10 X 10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

TTE	TETRACHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	103.400
40	103.099
45	102.900
50	102.599
55	102.299
60	102.000
65	101.700
70	101.400
75	101.099
80	100.799
85	100.500
90	100.200
95	99.910
100	99.610
105	99.320
110	99.020
115	98.730
120	98.429
125	98.139
130	97.839
135	97.549
140	97.250
145	96.959
150	96.669
155	96.370
160	96.080

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.198
10	.200
20	.201
30	.202
40	.203
50	.204
60	.205
70	.206
80	.207
90	.208
100	.210
110	.211
120	.212
130	.213
140	.214
150	.215
160	.216
170	.217
180	.218
190	.220
200	.221
210	.222

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
55	.958
60	.929
65	.900
70	.873
75	.848
80	.823
85	.800
90	.777
95	.756
100	.736
105	.716
110	.698
115	.680
120	.663
125	.647
130	.631
135	.616
140	.601
145	.588
150	.574
155	.561
160	.549
165	.537
170	.526
175	.515

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.016

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
60	.236
70	.318
80	.425
90	.561
100	.732
110	.948
120	1.217
130	1.548
140	1.953
150	2.446
160	3.042
170	3.756
180	4.607
190	5.616
200	6.805
210	8.199
220	9.824
230	11.710
240	13.890
250	16.390
260	19.260
270	22.520
280	26.230

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	.00702
70	.00929
80	.01216
90	.01575
100	.02022
110	.02571
120	.03242
130	.04055
140	.05032
150	.06199
160	.07583
170	.09215
180	.11130
190	.13360
200	.15940
210	.18910
220	.22330
230	.26230
240	.30660
250	.35680
260	.41330
270	.47680
280	.54790

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.108
25	.110
50	.113
75	.116
100	.118
125	.120
150	.122
175	.125
200	.127
225	.129
250	.131
275	.132
300	.134
325	.136
350	.138
375	.139
400	.141
425	.142
450	.143
475	.144
500	.146
525	.147
550	.148
575	.148
600	.149

2,4-DICHLOROPHENOL

DCP

Common Synonyms	Solid crystals	Colorless	Medicinal odor
	Sinks in water.		

Avoid contact with solid and dust. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.
SOLID OR DUST
Will burn skin and eyes.
Poisonous if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $HOC_6H_3Cl_2$-2,4
3.3 **IMO/UN Designation:** 6.1/2020
3.4 **DOT ID No.:** 2020
3.5 **CAS Registry No.:** 120-83-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** White
4.3 **Odor:** Strong medicinal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Bureau of Mines approved respirator, rubber gloves, chemical goggles.
5.2 **Symptoms Following Exposure:** Tremors, convulsions, shortness of breath, inhibition of respiratory system.
5.3 **Treatment of Exposure:** Inhalation-rest; Ingestion-drink water, epsom salt solution.
5.4 **Threshold Limit Value:** Not pertinent
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Not pertinent
5.9 **Liquid or Solid Irritant Characteristics:** Fairly severe skin irritant. May cause pain and second-degree burns after a few minutes' contact.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 200°F O.C.; 237°F C.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Water, foam, carbon dioxide, dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Water or foam may cause frothing.
6.5 **Special Hazards of Combustion Products:** Toxic gases can be evolved.
6.6 **Behavior in Fire:** Solid melts and burns.
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** May react vigorously with oxidizing materials
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 5 ppm/3 hours/rainbow trout/killed/fresh water; 5 ppm/12 hours/bluegills/killed/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 100%, 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 163.01
12.3 **Boiling Point at 1 atm:** 421°F = 216°C = 489°K
12.4 **Freezing Point:** 110°F = 45°C = 318°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.40 at 15°C (solid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

DCP	2,4-DICHLOROPHENOL

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.460		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

CHLORDANE

CDN

Common Synonyms	Liquid	Brown	Sharp odor
Chlordan 1, 2, 4, 5, 6, 7, 8, 8-octachloro-2, 3, 3a, 4, 7, 7a-hexahydro-4, 7-methanoindene Toxichlor; Octa-klor Velsicol 1068	Sinks in water.		

AVOID CONTACT WITH LIQUID. KEEP PEOPLE AWAY.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable but solution may be combustible.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Extinguish with dry chemicals, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID OR SOLUTION
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $C_{10}H_6Cl_8$
3.3 IMO/UN Designation: 6.1/2762
3.4 DOT ID No.: 2762
3.5 CAS Registry No.: 57-74-9

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Brown
4.3 Odor: Penetrating; aromatic; slightly pungent, like chlorine

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Respirator for sprays, fogs, or dust; goggles, rubber gloves.
5.2 Symptoms Following Exposure: Moderately irritating to eyes and skin. Ingestion, absorption through skin, or inhalation of mist or dust may cause excitability, convulsions, nausea, vomiting, diarrhea, and some local irritation of the gastrointestinal tract.
5.3 Treatment of Exposure: INHALATION: administer oxgen and give fluid therapy; do not give epinephrine, since it may induce ventricular fibrillation; enforce complete rest. EYES: flush with water for at least 15 min. SKIN: wash off skin with adequate quantities of soap and water; do NOT scrub. INGESTION: induce vomiting and follow with gastric lavage and administration of saline cathartics; ether and barbiturates may be used to control convulsions; oxygen and fluid therapy are also recommended; do NOT give epinephrine. Since no specific antidotes are known, symptomatic therapy must be accompanied by complete rest.
5.4 Threshold Limit Value: 0.5 mg/m³
5.5 Short Term Inhalation Limits: 2 mg/m³ for 30 min.
5.6 Toxicity by Ingestion: Grade 3; oral LD_{50} = 283 mg/kg (rat)
5.7 Late Toxicity: Possible liver damage; loss of appetite and weight.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 500 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Solution: 225°F O.C., 132°F C.C. Solid is not flammable.
6.2 Flammable Limits in Air: 0.7%-5% (kerosene solution)
6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective on solution fire.
6.5 Special Hazards of Combustion Products: Irritating and toxic hydrogen chloride and phosgene gases may be formed when kerosene solution of compound burns.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 410°F (kerosene solvent)
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: Not pertinent

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable to 160°F
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: 0.5 ppm/96 hr/goldfish/TL_m/fresh water
8.2 Waterfowl Toxicity: LD_{50} = 1,200 mg/kg
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical. A variety of dusts, powders, and solutions in kerosene containing 2-80% chlordane are shipped.
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 409.8
12.3 Boiling Point at 1 atm: Decomposes
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.6 at 25°C (liquid)
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: (est.) −4,000 Btu/lb = −2,200 cal/g = −93 X 10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

*Properties refer to undiluted, technical-grade chlordane.

6. FIRE HAZARDS (Continued)

6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

CDN	CHLORDANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
52	100.400
54	100.400
56	100.299
58	100.200
60	100.200
62	100.099
64	100.000
66	99.940
68	99.879
70	99.809
72	99.740
74	99.669
76	99.599
78	99.530
80	99.459
82	99.389
84	99.320
86	99.250

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
60	.300
61	.300
62	.300
63	.300
64	.300
65	.300
66	.300
67	.300
68	.300
69	.300
70	.300
71	.300
72	.300
73	.300
74	.300
75	.300
76	.300
77	.300

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)
60	1.209
61	1.209
62	1.209
63	1.209
64	1.209
65	1.209
66	1.209
67	1.209
68	1.209
69	1.209
70	1.209
71	1.209
72	1.209
73	1.209
74	1.209
75	1.209
76	1.209
77	1.209

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise (estimate)
130	58.980
140	51.140
150	44.560
160	38.990
170	34.270
180	30.240
190	26.780
200	23.810
210	21.240
220	19.020
230	17.080
240	15.390
250	13.900
260	12.590
270	11.440
280	10.420
290	9.516
300	8.710

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
215	.000
220	.000
225	.000
230	.000
235	.001
240	.001
245	.001
250	.002
255	.002
260	.003
265	.004
270	.006
275	.008
280	.011
285	.015
290	.019
295	.026
300	.035
305	.046
310	.060
315	.079
320	.104
325	.136
330	.177
335	.230
340	.297

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
215	.00001
220	.00001
225	.00002
230	.00002
235	.00003
240	.00005
245	.00007
250	.00009
255	.00012
260	.00017
265	.00023
270	.00031
275	.00042
280	.00056
285	.00074
290	.00099
295	.00131
300	.00174
305	.00228
310	.00300
315	.00391
320	.00510
325	.00662
330	.00856
335	.01104
340	.01418

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

NAPHTHALENE

NTM

Common Synonyms	Solid	Colorless	Mothballs odor
Naphthalin Tar camphor	Solidifies and floats or sinks in water.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and solid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Wear goggles and self-contained breathing apparatus.
Extinguish with water, foam, dry chemical or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.
SOLID OR LIQUID
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** $C_{10}H_8$
3.3 **IMO/UN Designation:** 4.1/2304
3.4 **DOT ID No.:** 2304
3.5 **CAS Registry No.:** 91-20-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Molten solid
4.2 **Color:** Colorless
4.3 **Odor:** Coal tar; moth balls

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved organic vapor canister unit; rubber gloves; chemical safety goggles; face shield; coveralls and/or rubber apron; rubber shoes or boots.
5.2 **Symptoms Following Exposure:** Vapors or fumes are irritating to eyes, nose, and throat and may cause headaches, dizziness, nausea, etc. Solid may be irritating to skin.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air. SKIN OR EYES: flush immediately with plenty of water for at least 15 min.; remove contaminated clothing immediately; call a physician.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 15 ppm for 5 min.
5.6 **Toxicity by Ingestion:** Grade 2; oral rat LD_{50} = 1780 mg/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Hot liquid can cause severe burn. The solid may irritate the skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 500 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 174°F C.C.; 190°F O.C.
6.2 **Flammable Limits in Air:** 0.9%-5.9%
6.3 **Fire Extinguishing Agents:** Water fog, carbon dioxide, dry chemical, or foam
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic vapors given off in a fire.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 979°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4.3 mm/mn.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Molten naphthalene spatters and foams in contact with water. No chemical reaction is involved.
7.2 **Reactivity with Common Materials:** None
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 150 mg/l/96 hr/sunfish/TL_m/fresh water
1.8 ppm/72 hr/fingerling salmon/critical/ salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** (theor.) 59.5%, 6 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Pure; crude: 95% Pure: mp = 176°F Crude: mp = 165—176°F
9.2 **Storage Temperature:** Elevated
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	3
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 128.18
12.3 **Boiling Point at 1 atm:** 424°F = 218°C = 491°K
12.4 **Freezing Point:** 176.4°F = 80.2°C = 353.4°K
12.5 **Critical Temperature:** 887.4°F = 475.2°C = 748.4°K
12.6 **Critical Pressure:** 588 psa = 40.0 atm = 4.05 MN/m²
12.7 **Specific Gravity:** 1.145 at 20°C (solid)
12.8 **Liquid Surface Tension:** 31.8 dynes/cm = 0.0318 N/m at 100°C
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.068
12.12 **Latent Heat of Vaporization:** 145 Btu/lb = 80.7 cal/g = 3.38 X 10^5 J/kg
12.13 **Heat of Combustion:** —16,720 Btu/lb = —9287 cal/g = —388.6 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 35.06 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Low

NOTES

NAPHTHALENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
177	69.290
178	69.290
179	69.290
180	69.290
181	69.290
182	69.290
183	69.290
184	69.290
185	69.290
186	69.290
187	69.290
188	69.290
189	69.290
190	69.290
191	69.290
192	69.290
193	69.290

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
180	.382
200	.391
220	.401
240	.410
260	.419
280	.429
300	.438
320	.447
340	.457
360	.466
380	.475
400	.485
420	.494

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)
177	.901
178	.901
179	.901
180	.901
181	.901
182	.901
183	.901
184	.901
185	.901
186	.901
187	.901
188	.901
189	.901
190	.901
191	.901
192	.901
193	.901

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
180	.837
185	.784
190	.735
195	.690
200	.648
205	.609
210	.573
215	.540
220	.509
225	.480
230	.454
235	.429
240	.406
245	.384
250	.364
255	.345
260	.327
265	.311
270	.295
275	.281
280	.267
285	.254
290	.242
295	.231
300	.221
305	.210

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.300

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
180	.148
200	.254
220	.420
240	.670
260	1.032
280	1.544
300	2.250
320	3.200
340	4.453
360	6.075
380	8.138
400	10.720
420	13.910
440	17.810
460	22.490
480	28.080

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
180	.00276
200	.00460
220	.00739
240	.01143
260	.01713
280	.02493
300	.03537
320	.04901
340	.06650
360	.08850
380	.11570
400	.14890
420	.18890
440	.23630
460	.29210
480	.35680

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.207
25	.220
50	.233
75	.246
100	.259
125	.271
150	.283
175	.295
200	.307
225	.318
250	.330
275	.340
300	.351
325	.362
350	.372
375	.382
400	.391
425	.401
450	.410
475	.419
500	.428
525	.436
550	.445
575	.453
600	.460

DIAZINON

DZN

Common Synonyms

O, O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidanyl) phosphorothioate
Alfa-tox
Spectracide
Saralex

Liquid — Light to dark brown

Sinks in water.

Stop discharge if possible. Keep people away.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable
POISONOUS GASES ARE PRODUCED WHEN HEATED.

Exposure

CALL FOR MEDICAL AID.

LIQUID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-poison, water contaminant, high flammability (if solution)
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{12}H_{21}N_2O_3PS$
3.3 **IMO/UN Designation:** 6.1/1615
3.4 **DOT ID No.:** 1615
3.5 **CAS Registry No.:** 333-41-5

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid or liquid solution
4.2 **Color:** Amber to dark brown
4.3 **Odor:** Data not available

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Goggles or face shield; rubber gloves; protective clothing.
5.2 **Symptoms Following Exposure:** Ingestion or prolonged inhalation of mist causes headache, giddiness, blurred vision, nervousness, weakness, cramps, diarrhea, discomfort in the chest, sweating, miosis, tearing, salivation and other excessive respiratory tract secretion, vomiting, cyanosis, papilledema, uncontrollable muscle twitches, convulsions, coma, loss of reflexes, and loss of sphincter control. Liquid irritates eyes and skin.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; keep warm; get medical attention at once. EYES: flush with plenty of water for at least 15 min. and get medical attention. SKIN: wash contaminated area with soap and water. INGESTION: get medical attention at once; give water slurry of charcoal; do NOT give milk or alcohol.
5.4 **Threshold Limit Value:** 0.1 mg/m³
5.5 **Short Term Inhalation Limits:** Not pertinent
5.6 **Toxicity by Ingestion:** Grade 3; oral LD_{50} = 76 mg/kg (rat)
5.7 **Late Toxicity:** May be mutagenic
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 82-105°F C.C. (solutions only; pure liquid difficult to burn)
6.2 **Flammable Limits in Air:** Not pertinent
6.3 **Fire Extinguishing Agents:** (for solutions) Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Oxides of sulfur and of phosphorus are generated in fires.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** (for solutions) 4 mm/min
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.025 ppm/96 hr/stonefly nymph/TL_m/fresh water
30 µg/l/48 hr/bluegill/TL_m/fresh water (becomes bound to soil when used according to directions)
8.2 **Waterfowl Toxicity:** LD_{50} = 3.54 mg/kg
LC_{50} = 5 days, 90 ppm mallard duck
LC_{50} = 7 days, 68 ppm quail
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical; wettable powders; a variety of emulsifiable solutions in combustible solvents.
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 304.4
12.3 **Boiling Point at 1 atm:** Very high; decomposes
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.117 at 20°C (liquid)
12.8 **Liquid Surface Tension:** (est.) 35 dynes/cm = 0.035 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** (est.) 40 dynes/cm = 0.040 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** (est.) −12,000 Btu/lb = −6,500 cal/g = −270 X 10^3 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

DZN	DIAZINON

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)	Temperature (degrees F)	Centipoise (estimate)
52	70.280	51	.400	51	1.048	51	4.064
54	70.209	52	.400	52	1.048	52	4.005
56	70.139	53	.400	53	1.048	53	3.948
58	70.070	54	.400	54	1.048	54	3.892
60	70.000	55	.400	55	1.048	55	3.836
62	69.929	56	.400	56	1.048	56	3.782
64	69.860	57	.400	57	1.048	57	3.729
66	69.790	58	.400	58	1.048	58	3.677
68	69.730	59	.400	59	1.048	59	3.625
70	69.660	60	.400	60	1.048	60	3.575
72	69.589	61	.400	61	1.048	61	3.525
74	69.520	62	.400	62	1.048	62	3.476
76	69.450	63	.400	63	1.048	63	3.428
78	69.379	64	.400	64	1.048	64	3.381
80	69.309	65	.400	65	1.048	65	3.335
82	69.240	66	.400	66	1.048	66	3.290
84	69.169	67	.400	67	1.048	67	3.245
86	69.099	68	.400	68	1.048	68	3.201
		69	.400	69	1.048	69	3.158
		70	.400	70	1.048	70	3.116
		71	.400	71	1.048	71	3.074
		72	.400	72	1.048	72	3.033
		73	.400	73	1.048	73	2.993
		74	.400	74	1.048	74	2.954
		75	.400	75	1.048	75	2.915
		76	.400	76	1.048	76	2.877

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	.004		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

DICHLORVOS

DCV

Common Synonyms	Liquid	Colorless to amber	Aromatic characteristic
DDVP Dichlorophos Vapona 2,2-dichlorovinyl O,O-dimethyl phosphate Nerkol	Sinks and mixes with water.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material
Notify local health and pollution control agencies.

Fire

Not flammable.

Exposure

CALL FOR MEDICAL AID.

VAPOR
POISONOUS IF INHALED OR SKIN IS EXPOSED.
Move to fresh air.
If breathing has stopped, give artificial respiration.

LIQUID
POISONOUS IF SWALLOWED OR SKIN IS EXPOSED.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning - poison, water contaminant.
Restrict access.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $(CH_3O)_2P(O)OCH{:}\ CCl_3$
$C_4H_7Cl_3O_4P$
3.3 **IMO/UN Designation:** 6.1/1615 (>2.5%); 9/1615 (>2.5%)
3.4 **DOT ID No.:** 1615
3.5 **CAS Registry No.:** 62-73-7

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless to amber
4.3 **Odor:** Aromatic characteristic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Wear safety glasses, gas mask, gloves, and top boots, overalls with long sleeves and closed collar.
5.2 **Symptoms Following Exposure:** First symptoms are headache, fatigue, dizziness, blurred vision, excessive sweating, nausea and vomiting, stomach cramps, diarrhea, and salivation. As poisoning progresses muscular twitching beginning with eyelids and tongue then face and neck, and finally, generalized twitching with profound muscular weakness. Constriction of pupils may be from systemic poisoning or local effect of spray in eye. A contact dermatitis may develop. Symptoms may be experienced during exposure or up to 8 hours later.
5.3 **Treatment of Exposure:** Call a physician. INHALATION: In the nonbreathing victim immediately institute artificial respiration. Treat in a cool place. EYES: Rinse with abundant water. SKIN: Flood and wash thoroughly with water. Remove contaminated clothing under a shower. INGESTION: Administer milk, water, or salt water and induce vomiting repeatedly. OTHER: As soon as local or systemic signs of intoxication are noted 2 mg (1/30 gr) of atropine should be administered intramuscularly or IV. Repeat every 3 to 6 minutes until signs of atropinization (mydriasis, dry mouth, rapid pulse hot and dry skin) occurs. For children use 1 mg of atropine. Keep airway clear.
5.4 **Threshold Limit Value:** 0.1 ppm.
5.5 **Short Term Inhalation Limits:** 0.3 ppm.
5.6 **Toxicity by Ingestion:** Grade 3: LD_{50} = 50 to 500 mg/kg.
5.7 **Late Toxicity:** Teratogenic effects. Workers exposed to low levels of pesticide suffered a decrease in serum and red cell cholinesterase. These workers had more health complaints (frequent headaches, dizziness, sore throat, nausea, etc.) than nonexposed workers.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 200 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Practically not flammable
6.2 **Flammable Limits in Air:** Not pertinent
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Stable to heat
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Corrosive to iron and mild steel.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.7 ppm/48-hour/Bluegill; LC_{50} 0.025 to 3.2 ppm/48-hour/6 fresh water Crustacea/TL_m
8.2 **Waterfowl Toxicity:** Young mallard LD_{50} = 7.8 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Persists 62 days in water 20°C
8.4 **Food Chain Concentration Potential:** Prolonged exposure to organophosphorus pesticides at concentrations as low as 0.01 ppb are toxic to marine animals due to bioconcentration.

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 220.98
12.3 **Boiling Point at 1 atm:** 284°F = 140°C = 413.2°K
12.4 **Freezing Point:** Data not available
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** 1.415 at 25°C
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Data not available
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

DCV	DICHLORVOS

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	SLIGHTLY SOLUBLE	105	.001	90	.00001		DATA NOT AVAILABLE
		110	.001	95	.00001		
		115	.001	100	.00001		
		120	.001	105	.00002		
		125	.002	110	.00003		
		130	.002	115	.00003		
		135	.003	120	.00004		
		140	.003	125	.00005		
				130	.00007		
				135	.00009		
				140	.00012		

DIELDRIN

DED

Common Synonyms	Solid	Light brown	Mild chemical odor
HEOD endo,exo-1,2,3,4,10,10-Hexachloro-6,7-expoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-dimethanonaphthalene	Sinks in water.		

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear goggles, dust respirator and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES MAY BE PRODUCED WHEN HEATED.

Exposure

CALL FOR MEDICAL AID.

DUST
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.
If inhaled will cause headache, dizziness, or loss of consciousness.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
If swallowed will cause headache, nausea, dizziness, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{12}H_8Cl_6O$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2761
3.5 **CAS Registry No.:** 60-57-1

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** Buff to light brown.
4.3 **Odor:** Mild chemical

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** U. S. Bu. Mines approved respirator; clean rubber gloves; goggles or face shield
5.2 **Symptoms Following Exposure:** Inhalation, ingestion, or skin contact causes irritability, convulsions and/or coma, nausea, vomiting, headache, fainting, tremors. Contact with eyes causes irritation.
5.3 **Treatment of Exposure:** INHALATION: move to fresh air; give oxygen and artificial respiration as required. INGESTION: induce vomiting and get medical attention. EYES: flush with plenty of water; get medical attention. SKIN: flush with plenty of water.
5.4 **Threshold Limit Value:** 0.25 mg/m³
5.5 **Short Term Inhalation Limits:** 1 mg/m³ for 30 min.
5.6 **Toxicity by Ingestion:** Grade 4; oral LD_{50} = 46 mg/kg (rat), 65 mg/kg (dog)
5.7 **Late Toxicity:** Banned by EPA in October 1974 because of alleged "imminent hazard to human health" as a potential carcinogen in man.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.041 ppm
5.11 **IDLH Value:** 450 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Data not available
6.5 **Special Hazards of Combustion Products:** Toxic and irritating hydrogen chloride fumes may form in fire.
6.6 **Behavior in Fire:** Data not available
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Data not available
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.0079 mg/1/96 hr/bluegill/TL_m/fresh water
.037 ppm/96 hr/goldfish/TL_m/fresh water
0.050 ppm/5 hr/mullet/100% kill/salt water
0.025-.050 ppm/48 hr/brown shrimp/TL_m/ salt water
8.2 **Waterfowl Toxicity:** LD_{50} 381.0 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** High

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical, 85+ % HEOD; 18% emulsifiable concentrates in petroleum hydrocarbons, which are combustible.
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) (for liquid form)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 380.93
12.3 **Boiling Point at 1 atm:** Not pertinent (decomposes)
12.4 **Freezing Point:** 349°F = 176°C = 449°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.75 at 20°C (solid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

DIURON

DIU

Common Synonyms	Solid	White	Odorless
Diurex Karmex Marmer Dichlorfendasm Di-on			

Avoid contact with solid and dust. Keep people away.
Wear goggles, self-contained breathing apparatus and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GAS MAY BE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus and rubber overclothing.

Exposure

CALL FOR MEDICAL AID.

SOLID
Irritating to skin, eyes, nose and throat.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be harmful if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $(C_6H_3Cl_2)NHCON(CH_3)_2$
$C_9H_{10}Cl_2N_2O$
3.3 **IMO/UN Designation:** 6.1/1609 (>10%); 9/1609 (<10%)
3.4 **DOT ID No.:** 1609
3.5 **CAS Registry No.:** 330-54-1

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid
4.2 **Color:** White
4.3 **Odor:** None

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Self-contained breathing apparatus, rubber gloves, suits and boots.
5.2 **Symptoms Following Exposure:** INHALATION: May cause irritation of nose and throat. EYES: Irritation. SKIN: Moderately irritating to skin.
5.3 **Treatment of Exposure:** Call a doctor. Move to fresh air. EYES: Flush with water. SKIN: Wash with soap and water. INGESTION: Ingestion of solid - give activated charcoal followed in 3 to 4 hours by sodium sulfate as cathartic. For large doses, gastric lavage may be indicated.
5.4 **Threshold Limit Value:** 10 mg/m³.
5.5 **Short Term Inhalation Limits:** 20 mg/m³.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg.
5.7 **Late Toxicity:** Suspected of affecting DNA (Potential mutagen). Repeated doses produce anemia in rats and perhaps methemoglobinemia if the compound is hydrolyzed in vivo to dichloroaniline. At 2500 ppm for two years growth was retarded in both rats and dogs.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** No appreciable hazard. Practically harmless to skin.
5.10 **Odor Threshold:** Not pertinent
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** Not pertinent
6.2 **Flammable Limits in Air:** Not pertinent
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Highly toxic fumes are imminent
6.6 **Behavior in Fire:** Decomposes at 180° to 190°C
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Iable Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
4.0 ppm/96-hour/Bluegill/LD_{50}
3 ppm/24-hour/Striped bass fingerling/LC_{50}
42 ppm/48-hour/Large mouth bass/LC_{50}
4.3 ppm/48-hour/Rainbow trout/LC_{50}
8.2 **Waterfowl Toxicity:** LD_{50} Young mallards = >2000 ppm LD_{50} Mallard 5 day = >5000 ppm
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Accumulates markedly in fish tissues

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Wettable powder 80% Granular 8%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-E
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 233.1
12.3 **Boiling Point at 1 atm:** 356 to 374°F = 180 to 190°C = 453.2 to 463.2°K
12.4 **Freezing Point:** 316.4 to 318.2°F = 158 to 159°C = 431.2 to 432.2°K
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** Data not available
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 8.04
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

DIURON

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77	.004		DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE

KEPONE

KPE

Common Synonyms	Crystalline solid	Colorless	Odorless
Chlordecone Merex GC-1189 ENT-16391 Merex Decachloroketone			

Avoid contact with solid or dust. Keep people away.
Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Fire data not available.

Exposure

CALL FOR MEDICAL AID.

SOLID OR DUST
POISONOUS IF SWALLOWED, INHALED, OR IF SKIN IS EXPOSED.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant.
Restrict access.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $C_{10}Cl_{10}O$
3.3 IMO/UN Designation: 6.1/1615 (>10%); 9/1615 (<10%)
3.4 DOT ID No.: NA2761
3.5 CAS Registry No.: 143-50-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: Colorless
4.3 Odor: Odorless

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves, self-contained breathing apparatus, and protective clothing.
5.2 Symptoms Following Exposure: INHALATION AND INGESTION: These symptoms present in all affected patients - Neurologic impairment - anxiety, irritability, memory disturbance, headache, tremors, opsoclonus, stuttering, slurred speech, and abnormal tandem gait.
5.3 Treatment of Exposure: Call a physician. INHALATION: Remove from exposure. EYES: Flush with copious amounts of water. SKIN: Wash thoroughly with soap and water. INGESTION: Induce emesis or perform gastric lavage. Give saline cathartic. Barbiturates to control tremors or convulsions.
5.4 Threshold Limit Value: $<1\ \mu g/m^3$ up to 10-hour day and 40-hour week, NIOSH Recommendation (1976).
5.5 Short Term Inhalation Limits: $<3\ \mu g/m^3$ (estimated).
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg.
5.7 Late Toxicity: 80-week rat and mouse study. 2-dose levels - generalized tumors and dermatologic changes. Significant increase in hepatocellular carcinomas. Hyperplasia of liver. Neurologic symptoms, sterility; brain and liver damage, fetal toxicity; teratogenic effects, anemia.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Not pertinent
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: Data not available
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Data not available
6.4 Fire Extinguishing Agents Not to be Used: Data not available
6.5 Special Hazards of Combustion Products: Data not available
6.6 Behavior in Fire: Data not available
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: Data not available
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Data not available
7.2 Reactivity with Common Materials: Data not available
7.3 Stability During Transport: Data not available
7.4 Neutralizing Agents for Acids and Caustics: Data not available
7.5 Polymerization: Data not available
7.6 Inhibitor of Polymerization: Data not available
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.066 ppm/24-hour/Rainbow trout/LC_{50}
0.5 ppm/24-hour/Juvenile white mullet/LC_{50}
0.055 ppm/48-hour/Juvenile white mullet/LC_{50}
0.3 ppm/24-hour/Longnose killifish/LC_{50}
0.084 ppm/48-hour/Longnose killifish/LC_{50}
0.0375 ppm/48-hour/Rainbow trout/LC_{50}
8.2 Waterfowl Toxicity: Data not available

(Continued)

9. SHIPPING INFORMATION

9.1 Grades of Purity: 50% Wettable powder; 2% to 4% Baits
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-E
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 490.68
12.3 Boiling Point at 1 atm: Sublimes with decomposition at 350°C
12.4 Freezing Point: 662°F = 349°C = 623.2°K
12.5 Critical Temperature: Data not available
12.6 Critical Pressure: Data not available
12.7 Specific Gravity: Data not available
12.8 Liquid Surface Tension: Data not available
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: Data not available
12.11 Ratio of Specific Heats of Vapor (Gas): Data not available
12.12 Latent Heat of Vaporization: Data not available
12.13 Heat of Combustion: Data not available
12.14 Heat of Decomposition: Data not available
12.15 Heat of Solution: Data not available
12.16 Heat of Polymerization: Data not available
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

8. WATER POLLUTION (Continued)

8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Highly bioaccumulative (425 to 20,000 times

KEPONE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
212	.470		NOT PERTINENT		NOT PERTINENT		DATA NOT AVAILABLE

MALATHION

MLT

Common Synonyms
Cythion Insecticide

Liquid Yellow to dark brown Skunk-like odor

Sinks in water. Freezing point is 37°F.

AVOID CONTACT WITH LIQUID. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE AND WHEN HEATED.
Containers may explode in fire.
Wear chemical protective suit with self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, water, or foam.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{10}H_{19}O_6PS_2$
3.3 **IMO/UN Designation:** 6.1/2783
3.4 **DOT ID No.:** 2783
3.5 **CAS Registry No.:** 121-75-5

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Yellow to dark brown.
4.3 **Odor:** Charactenstic skunk-like mercaptan

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Wear self-contained breathing apparatus (or respirator for organophosphate pesticides) and rubber clothing while fighting fires of malathion with chlorine bleach solution. All clothing contaminated by fumes and vapors must be decontaminated.

5.2 **Symptoms Following Exposure:** Exposure to fumes from a fire or to liquid causes headache, blurred vision, constricted pupils of the eyes, weakness, nausea, cramps, diarrhea, and tightness in the chest. Muscles twitch and convulsions may follow. The symptoms may develop over a period of 8 hours.

5.3 **Treatment of Exposure:** Speed is essential. INHALATION: in the nonbreathing victim immediately institute artificial respiration, using the mouth-to-mouth, the mouth-to-nose, or the mouth-to-oropharyngeal method. Call physician INGESTION: administer milk, water or salt-water and induce vomiting repeatedly. SKIN OR EYE CONTACT: flood and wash exposed skin areas thoroughly with water. Remove contaminated clothing under a shower. Administer atropine, 2 mg(1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3-8 min. until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 1 mg of atropine. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. Give 2-PAM (Pralidoxime; Protopam), 2.5 gm in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15-30 min.; if sufficient fluid is not available, give 1 gm of 2-PAM in 3 ml of distilled water by deep intramuscular injection: repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur.

5.4 **Threshold Limit Value:** 10 mg/m³
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5g/kg(rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** None likely
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.

(Continued)

6. FIRE HAZARDS

6.1 **Flash Point:** >325°F
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Dry chemical, carbon dioxide, water spray, foam
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Vapors and fumes from fires are hazardous. They include sulfur dioxide and phosphoric acid.
6.6 **Behavior in Fire:** Gives off hazardous fumes. Area surrounding fire should be diked to prevent water runoff.
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** None
7.2 **Reactivity with Common Materials:** No hazardous reaction
7.3 **Stability During Transport:** Not pertinent
7.4 **Neutralizing Agents for Acids and Caustics:** Liquid bleach solution for decontamination.
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 0.09 ppm/96 hr/bluegill/TL_m/fresh water
0.033-0.083 ppm/96 hr/marine crustacean/LC_{50}
8.2 **Waterfowl Toxicity:** LD_{50} = 1485 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** CYTHION Insecticide; Malathion ULV Concentrate Insecticide. Many powders, dusts, and spray solutions are sold under a variety of trade names.
9.2 **Storage Temperature:** Below 120°F. Decomposition (non-hazardous) occurs at higher temperatures.
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 330.36
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** 37°F = 2.9°C = 276°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.234 at 25°C (liquid)
12.8 **Liquid Surface Tension:** 37.1 dynes/cm = 0.0371 N/m at 24°C
12.9 **Liquid Water Interfacial Tension:** 19 dynes/cm = 0.019 N/m at 24°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

5. HEALTH HAZARDS (Continued)

5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 5000 mg/m³

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

MLT	MALATHION

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
77	77.089	85	.380		N	70	45.270
78	77.089	90	.384		O	72	42.680
79	77.089	95	.389		T	74	40.260
80	77.089	100	.393			76	37.990
81	77.089	105	.398		P	78	35.870
82	77.089	110	.402		E	80	33.880
83	77.089	115	.406		R	82	32.020
84	77.089	120	.411		T	84	30.270
85	77.089	125	.415		I	86	28.620
86	77.089	130	.420		N	88	27.080
87	77.089	135	.424		E	90	25.630
88	77.089	140	.429		N	92	24.270
89	77.089	145	.433		T	94	22.990
90	77.089	150	.438			96	21.780
91	77.089					98	20.650
92	77.089					100	19.580
93	77.089					102	18.580
94	77.089					104	17.630
95	77.089					106	16.740
96	77.089					108	15.900
97	77.089					110	15.100
98	77.089					112	14.350
99	77.089					114	13.650
100	77.089					116	12.980
101	77.089					118	12.350
102	77.089					120	11.750

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77.02	.014		N		N		N
			O		O		O
			T		T		T
			P		P		P
			E		E		E
			R		R		R
			T		T		T
			I		I		I
			N		N		N
			E		E		E
			N		N		N
			T		T		T

NALED

NLD

Common Synonyms

Dibrom
Arthodibrom
Bromex
1, 2-Dibromo-2, 2-dichloroethyl dimethyl phosphate

Solid or liquid | White (solid) Light straw (liquid) | Slightly pungent

Sinks and mixes slowly with water.

Avoid contact with liquid. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.

Exposure

CALL FOR MEDICAL AID.

SPRAY OR DUST
POISONOUS IF INHALED.
Irritating to skin and eyes.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID OR SOLID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant.
Restrict access.
Should be removed.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_4H_7Br_2Cl_2O_4P$
3.3 **IMO/UN Designation:** 6.1/2783 (>2.5%); 9/2783 (<25%)
3.4 **DOT ID No.:** 2783
3.5 **CAS Registry No.:** 300-76-5

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Yellow
4.3 **Odor:** Slightly pungent

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Rubber gloves, self-contained breathing apparatus, protective clothing.
5.2 **Symptoms Following Exposure:** INHALATION OR INGESTION: Symptoms secondary to cholinesterase inhibition are: headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, chest discomfort, sweating, miosis, tearing, salivation, and other excessive respiratory tract secretion, vomiting, cyanosis, muscle twitching, and convulsions. EYES: Irritating. SKIN: Irritating-can cause dermatitis.
5.3 **Treatment of Exposure:** Call a physician. INHALATION: Artificial respiration when needed. EYES: Irrigate with physiological saline or water. SKIN: Remove clothing and bathe thoroughly using lots of water and soap. When skin appears clear, bathe or swab with ethyl alcohol. INGESTION: Induce vomiting, give milk or water, and induce vomiting again. OTHER: Atropinize the patient immediately with 1 to 4 mg IM. To maintain atropinization, 2-mg doses at intervals of 15 to 60 minutes.
5.4 **Threshold Limit Value:** 3 mg/m³.
5.5 **Short Term Inhalation Limits:** 6 mg/m³.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg.
5.7 **Late Toxicity:** Cholinesterase inhibition persists for several weeks making person more vulnerable in case of additional exposure. Exposure of rats at 0.3 to 2.5 mg/l 4 hours daily for 6 months caused emphysema, interstitial pneumonia, bronchitis, and peribronchitis. Liver, spleen, and brain damage was noted.
5.8 **Vapor (Gas) Irritant Characteristics:** Dangerous concentrations of vapor are not produced under normal conditions.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Data not available
6.4 **Fire Extinguishing Agents Not to be Used:** Data not available
6.5 **Special Hazards of Combustion Products:** Data not available
6.6 **Behavior in Fire:** Data not available
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Unstable in presence of iron
7.3 **Stability During Transport:** Stable under anhydrous conditions. Unstable in alkaline conditions. Degraded by sunlight.
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
24-hour LC_{50} (Bluegills) = 0.22 mg/l
48-hour LC_{50} (Brook trout) = 0.078 mg/l
96-hour LC_{50} (Bluegills) = 0.18 mg/l
24-hour LC_{50} (Rainbow trout) = 1.3 mg/l at 1.6°C, 0.62 mg/l at 7.2°C, and 0.24 mg/l at 12.7°C
8.2 **Waterfowl Toxicity:** Oral LD_{50} (Mallards) = 52.2 mg/kg Oral LD_{50} (Canada geese) = 38.9 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Hydrolyzes; Degrades rapidly in soil and water.
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical, 93%
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

AX

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-E
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 381
12.3 **Boiling Point at 1 atm:** ≥392°F = ≥200°C = 473.2°K
12.4 **Freezing Point:** Pure 80.6°F = 27°C = 300.2°K
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** 1.97 at 20°C
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** 13.1 (calculated)
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

NLD	NALED

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		DATA NOT AVAILABLE		DATA NOT AVAILABLE

PYRETHRINS

PRR

Common Synonyms	Viscous liquid	Yellow to brown	Characteristic odor of carrier
Persian-insect powder Pyrethrum flowers Dalmation-insect powder	Sinks in water.		

Avoid contact with liquid, vapor, or dust. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES MAY BE PRODUCED IN FIRE OR WHEN HEATED.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to skin and eyes.
If inhaled, may cause sneezing, nasal discharge, and nasal stuffiness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed may cause nausea, vomiting, headache, and other CNS disturbances.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning - water contaminant.
Should be removed.
Chemical and physical treatment.
Disperse and flush.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{21}H_{28}O_3$ - Pyrethrin I
$C_{22}H_{28}O_5$ - Pyrethrin II
$C_{20}H_{28}O_3$ - Cinerin I
$C_{21}H_{28}O_5$ - Cinerin II
3.3 **IMO/UN Designation:** 6.1/9184 (>5%); 9/9184 (<5%)

(Continued)

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Viscous liquid
4.2 **Color:** Yellow to brown
4.3 **Odor:** Characteristic odor of carrier

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective clothing and filter mask recommended.
5.2 **Symptoms Following Exposure:** INHALATION: Sneezing, serous nasal discharge, nasal stuffiness. A few cases of extrinsic asthma have been reported. Rare: anaphylactic reaction, peripheral vascular collapse and respiratory difficulty. EYES: May be irritating. SKIN: Contact dermatitis - a mild erythematous, vesicular dermatitis with papules in moist areas and intense pruritis. INGESTION: Excitation - to convulsions - to tetanic paralysis; muscular fibrillations; death from respiratory failure.
5.3 **Treatment of Exposure:** Call a doctor. INHALATION: Symptomatic - antihistamines are of value. EYES: Flush with water. SKIN: Wash with soap and water. INGESTION: Gastric lavage followed by saline catharsis. For nervous manifestations pentobarbitol should be used. Diarrhea can be controlled with atropine sulfate.
5.4 **Threshold Limit Value:** 5 mg/m³.
5.5 **Short Term Inhalation Limits:** 10 mg/m³.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg.
5.7 **Late Toxicity:** May cause hypersensitive reaction, especially following previous sensitizing exposure. May cause eczematous dermatitis.
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 5,000 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Highly toxic fumes are imminent.
6.6 **Behavior in Fire:** Data not available
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Data not available
7.3 **Stability During Transport:** Unstable in the presence of light, moisture and air.
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
24-hour LC_{50} Rainbow trout = 0.56 ppm
24-hour LC_{50} Bluegills = 0.078 ppm
24-hour LC_{50} Mosquito fish = 0.027 ppm
24-hour LC_{50} Mosquito fish = 93 ppm
96-hour LC_{50} Bluegills = 74 ppm
96-hour LC_{50} Channel catfish = 80 ppm
96-hour LC_{50} Rainbow trout = 54 ppm
8.2 **Waterfowl Toxicity:** Oral LD_{50} Young mallards = >10,000 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Cool
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 328.4 Pyrethrin I; 372.4 Pyrethrin II; 316.4 Cinerin I; 360.4 Cinerin II
12.3 **Boiling Point at 1 atm:**
338°F = 170°C = 443.2°K (Pyrethrin I)
392°F = 200°C = 473.2°K (Pyrethrin II)
279°F = 137°C = 410.2°K (Cinerin I)
361°F = 183°C = 456.2°K (Cinerin II)
12.4 **Freezing Point:** Data not available
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** Data not available
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Data not available
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

3. CHEMICAL DESIGNATIONS (Continued)

3.4 **DOT ID No.:** 9184
3.5 **CAS Registry No.:** 8003-73-7

PRR	PYRETHRINS

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE		DATA NOT AVAILABLE

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		DATA NOT AVAILABLE

TURPENTINE

TPT

Common Synonyms	Watery liquid	Colorless	Penetrating, unpleasant odor
Spirit of turpentine Turps Gum turpentine Wood turpentine D.D. turpentine Sulfate turpentine	Floats on water. Irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, difficult breathing, or loss of consciousness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Olefin
3.2 Formula: $C_{10}H_{16}$
3.3 IMO/UN Designation: 3.3/1299
3.4 DOT ID No.: 1299
3.5 CAS Registry No.: 8006-64-2

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic, rather unpleasant, penetrating

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic canister or air-supplied mask; goggles or face shield; rubber gloves.
5.2 Symptoms Following Exposure: Vapors cause headache, confusion, respiratory distress. Liquid irritates skin. If ingested, can irritate the entire digestive system and may injure kidneys. If liquid is taken into lungs, causes severe pneumonitis.
5.3 Treatment of Exposure: INHALATION: remove victim to fresh air; call a doctor; administer artificial respiration and oxygen if required. INGESTION: give water and induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 1,900 ppm

6. FIRE HAZARDS

6.1 Flash Point: 95°F C.C.
6.2 Flammable Limits in Air: 0.8% (LEL)
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Forms heavy black smoke and soot
6.7 Ignition Temperature: 488°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 2.4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 30

8. WATER POLLUTION

8.1 Aquatic Toxicity: 100 ppm/*/fish/toxic/fresh water
*Time period not specified.
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: A wide variety of grades and purities are shipped. All have about the same hazardous properties.
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 302—320°F = 150—160°C = 423—433°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.86 at 15°C (liquid)
12.8 Liquid Surface Tension: Data not available
12.9 Liquid Water Interfacial Tension: 14 dynes/cm = 0.014 N/m at 22.7°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.26 psia

NOTES

TPT	TURPENTINE

12.17 URATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
32	53.680
34	53.680
36	53.680
38	53.680
40	53.680
42	53.680
44	53.680
46	53.680
48	53.680
50	53.680
52	53.680
54	53.680
56	53.680
58	53.680
60	53.680
62	53.680
64	53.680
66	53.680

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
28	.411
30	.411
32	.411
34	.411
36	.411
38	.411
40	.411
42	.411
44	.411
46	.411
48	.411
50	.411
52	.411
54	.411
56	.411
58	.411
60	.411
62	.411
64	.411
66	.411

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)
32	1.040
34	1.040
36	1.040
38	1.040
40	1.040
42	1.040
44	1.040
46	1.040
48	1.040
50	1.040
52	1.040
54	1.040
56	1.040
58	1.040
60	1.040
62	1.040
64	1.040
66	1.040

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
46	1.838
48	1.802
50	1.767
52	1.733
54	1.700
56	1.668
58	1.636
60	1.606
62	1.576
64	1.547
66	1.519
68	1.491
70	1.464
72	1.438
74	1.413
76	1.388
78	1.364
80	1.340
82	1.317
84	1.294
86	1.272
88	1.251
90	1.230
92	1.210
94	1.190
96	1.170

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	.525
60	.561
65	.597
70	.636
75	.676
80	.718
85	.761
90	.807
95	.854
100	.903
105	.954
110	1.007
115	1.061
120	1.118
125	1.177
130	1.237

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

2, 4-D ESTERS

DES

Common Synonyms	Liquid	Yellowish brown	Fuel oil-like odor
Butyl 2,4-Dichlorophenoxyacetate Isopropyl 2, 4-dichlorophenoxy acetate 2, 4-Dichlorophenoxyacetic acid, butoxyethyl ester	Sinks in water.		

Stop discharge if possible. Keep people away.
Shut off ignition sources. Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Irritating gases may be produced when heated.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemicals, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED, and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $2,4\text{-}Cl_2C_6H_3OCH_2COOR$, where $R = C_4H_9$, C_8H_{17}, or $CH_2CH_2OC_4H_9$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2765
3.5 **CAS Registry No.:** 94-11-1

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Brown; amber
4.3 **Odor:** May have odor of fuel oil.

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Face shield or goggles, rubber gloves
5.2 **Symptoms Following Exposure:** Contact with eyes may cause mild irritation.
5.3 **Treatment of Exposure:** INGESTION: if large amounts are swallowed, induce vomiting and get medical help. EYES: flush with plenty of water and see a doctor. SKIN: flush with water, wash with soap and water.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2 or 3: LD_{50} = 320-617 mg/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** > 175°F O.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Irritating hydrogen chloride vapor may form in fire.
6.6 **Behavior in Fire:** Data not available
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** May attack some forms of plastics
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 350 ppm/24 hr/bass, bluegill/50% kill/fresh water
1.0-5.0 ppm/96 hr/oyster/39% shell growth disease/salt water
8.2 **Waterfowl Toxicity:** LD_{50} = 2025.0 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical, 99%; 64% in petroleum oil
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-E
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 234-291
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.088-1.237 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

DES	2,4-D ESTERS

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
68	71.790		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

DICHLOROMETHANE

DCM

Common Synonyms	Watery liquid	Colorless	Sweet, pleasant odor
Methylene chloride Methylene dichloride	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible
Avoid contact with liquid and vapor
Isolate and remove discharged material
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea and dizziness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Disperse and flush

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** CH_2Cl_2
3.3 **IMO/UN Designation:** 9.0/1593
3.4 **DOT ID No.:** 1593
3.5 **CAS Registry No.:** 75-09-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pleasant, aromatic; like chloroform; sweet, ethereal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor canister mask, safety glasses, protective clothing.
5.2 **Symptoms Following Exposure:** INHALATION: anesthetic effects, nausea and drunkenness. CONTACT WITH SKIN AND EYES: skin irritation, irritation of eyes and nose.
5.3 **Treatment of Exposure:** INHALATION: remove from exposure. Give oxygen if needed. INGESTION: no specific antidote. CONTACT WITH SKIN AND EYES: remove contaminated clothing; wash skin or eyes if affected.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 500 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 205-307 ppm
5.11 **IDLH Value:** 5,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable under conditions likely to be encountered.
6.2 **Flammable Limits in Air:** 12%-19%
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Dissociation products generated in a fire may be irritating or toxic.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 1184°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Not pertinent
8.2 **Waterfowl Toxicity:** Not pertinent
8.3 **Biological Oxygen Demand (BOD):** Not pertinent
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Aerosol grade; technical grade
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Inerted
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	1
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	0
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 84.93
12.3 **Boiling Point at 1 atm:** 104°F = 39.8°C = 313.0°K
12.4 **Freezing Point:** −142°F = −96.7°C = 176.5°K
12.5 **Critical Temperature:** 473°F = 245°C = 518°K
12.6 **Critical Pressure:** 895 psia = 60.9 atm = 6.17 MN/m²
12.7 **Specific Gravity:** 1.322 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 2.9
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.199
12.12 **Latent Heat of Vaporization:** 142 Btu/lb = 78.7 cal/g = 3.30 X 10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 16.89 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 13.9 psia

NOTES

DCM	DICHLOROMETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—70	91.320
—60	90.700
—50	90.080
—40	89.450
—30	88.830
—20	88.200
—10	87.580
0	86.959
10	86.330
20	85.709
30	85.080
40	84.459
50	83.830
60	83.209
70	82.589
80	81.959
90	81.341
100	80.709

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.274
40	.275
45	.276
50	.277
55	.278
60	.279
65	.279
70	.280
75	.281
80	.282
85	.283
90	.284
95	.284
100	.285

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—110	1.205
—100	1.192
—90	1.179
—80	1.166
—70	1.154
—60	1.141
—50	1.128
—40	1.115
—30	1.102
—20	1.090
—10	1.077
0	1.064
10	1.051
20	1.038
30	1.025
40	1.013
50	1.000
60	.987
70	.974
80	.961

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	1.380

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—10	.866
—5	1.013
0	1.180
5	1.370
10	1.586
15	1.830
20	2.105
25	2.414
30	2.762
35	3.151
40	3.585
45	4.068
50	4.606
55	5.201
60	5.860
65	6.588
70	7.389
75	8.270
80	9.237
85	10.300

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—10	.01525
—5	.01763
0	.02031
5	.02333
10	.02671
15	.03050
20	.03472
25	.03941
30	.04462
35	.05039
40	.05676
45	.06378
50	.07149
55	.07996
60	.08922
65	.09934
70	.11040
75	.12240
80	.13540
85	.14960

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.126
10	.129
20	.131
30	.133
40	.135
50	.137
60	.139
70	.142
80	.144
90	.145
100	.147
110	.149
120	.151
130	.153
140	.155
150	.156
160	.158
170	.159
180	.161
190	.163
200	.164
210	.165
220	.167
230	.168
240	.169
250	.171

ETHYLBENZENE

ETB

Common Synonyms	Liquid	Colorless	Sweet, gasoline-like odor
Phenylethane EB	Floats on water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shorelines.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic hydrocarbon
3.2 Formula: $C_6H_5CH_2CH_3$
3.3 IMO/UN Designation: 3.3/1175
3.4 DOT ID No.: 1175
3.5 CAS Registry No.: 100-41-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles.
5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters.
5.3 Treatment of Exposure: INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 Odor Threshold: 140 ppm
5.11 IDLH Value: 2,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 80°F O.C.; 59°F C.C.
6.2 Flammable Limits in Air: 1.0%-6.7%
6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated.
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back.
6.7 Ignition Temperature: 860°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 5.8 mm/min.
6.10 Adiabatic Flame Temperature: Data Not Available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data Not Available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 29 ppm/96 hr/bluegill/TL$_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.17
12.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K
12.4 Freezing Point: —139°F = —95°C = 178°K
12.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K
12.6 Critical Pressure: 523 psa = 35.6 atm = 3.61 MN/m²
12.7 Specific Gravity: 0.867 at 20°C (liquid)
12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35 X 10⁵ J/kg
12.13 Heat of Combustion: —17,780 Btu/lb = —9877 cal/g = —413.5 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.28 Heat of Fusion: Data Not Available
12.26 Limiting Value: Data Not Available
12.27 Reid Vapor Pressure: 0.4 psia

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data Not Available
6.12 Flame Temperature: Data Not Available

ETB ETHYLBENZENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	54.990
50	54.680
60	54.370
70	54.060
80	53.750
90	53.430
100	53.120
110	52.810
120	52.500
130	52.190
140	51.870
150	51.560
160	51.250
170	50.940
180	50.620
190	50.310
200	50.000
210	49.690

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
40	.402
50	.404
60	.407
70	.409
80	.412
90	.414
100	.417
110	.419
120	.421
130	.424
140	.426
150	.429
160	.431
170	.434
180	.436
190	.439
200	.441
210	.443

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—90	1.065
—80	1.056
—70	1.047
—60	1.037
—50	1.028
—40	1.018
—30	1.009
—20	1.000
—10	.990
0	.981
10	.971
20	.962
30	.953
40	.943
50	.934
60	.924
70	.915
80	.906
90	.896
100	.887
110	.877
120	.868
130	.859
140	.849
150	.840
160	.830

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
40	.835
50	.774
60	.719
70	.670
80	.626
90	.586
100	.550
110	.518
120	.488
130	.461
140	.436
150	.414
160	.393
170	.374
180	.356
190	.340
200	.325
210	.311

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.020

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
80	.202
100	.370
120	.644
140	1.071
160	1.713
180	2.643
200	3.953
220	5.747
240	8.147
260	11.290
280	15.320
300	20.410
320	26.730
340	34.460
360	43.800
380	54.950

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
80	.00370
100	.00654
120	.01099
140	.01767
160	.02734
180	.04087
200	.05926
220	.08363
240	.11520
260	.15510
280	.20490
300	.26570
320	.33910
340	.42620
360	.52850
380	.64720

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—400	—.007
—350	.026
—300	.060
—250	.093
—200	.125
—150	.157
—100	.187
—50	.217
0	.246
50	.274
100	.301
150	.327
200	.353
250	.377
300	.401
350	.424
400	.446
450	.467
500	.487
550	.507
600	.525

o-CHLOROPHENOL

CRH

Common Synonyms	Liquid	Colorless to amber	Unpleasant, penetrating
Phenol,2-chloro- Phenol, o-chloro- 2-chloro-1-hydroxybenzene 2-Hydroxychlorobenzene	Sinks and slowly mixes.		

AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY.
Wear positive pressure breathing apparatus and special chemical protective clothing.
Stop discharge if possible. Call fire department.
Shut off ignition sources.
Stay upwind and use water spray to knock down vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

COMBUSTIBLE.
POISONOUS GASES ARE PRODUCED IN FIRE.
CONTAINERS MAY EXPLODE IN FIRE.
Wear positive breathing apparatus and special chemical protective clothing.
Combat fires from safe distance or protected location.
Extinguish small fires with dry chemical, carbon dioxide, water spray or foam; large fires with water spray, fog or foam.

Exposure

CALL FOR MEDICAL AID.

VAPOR
POISONOUS. MAY BE FATAL IF INHALED OR ABSORBED THROUGH SKIN.
Inhalation can cause liver and kidney damage.
Irritating to skin and eyes.
Move victim to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
POISONOUS. MAY BE FATAL IF SWALLOWED OR ABSORBED THROUGH SKIN.
Can cause severe skin and eye irritation; may cause burns.
IF IN EYES OR ON SKIN, flush contaminated area with running water for at least 15 minutes; hold upper and lower eyelids open occasionally if appropriate.
Speed in removing material from skin is extremely important.
Remove and isolate contaminated clothing and shoes.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning - poison; water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Not listed
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** C_6H_5ClO
3.3 **IMO/UN Designation:** 6.1/2021
3.3 **IMO/UN Designation:** 2021
3.5 **CAS Registry No.:** 95-57-8

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless to light amber
4.3 **Odor:** Unpleasant, penetrating

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Wear positive pressure breathing apparatus and special chemical protective clothing.
5.2 **Symptoms Following Exposure:** Poisonous; may be fatal if inhaled, swallowed or absorbed through skin. Irritating to skin and eyes; direct contact may cause burns. Rats receiving lethal doses via oral, subcutaneous or intraperitoneal routes displayed similar symptoms: restlessness, increased breathing rate and motor weakness followed by tremors, chronic convulsions, dyspnea, coma and death.
5.3 **Treatment of Exposure:** INHALATION: Move victim to fresh air; call emergency medical care. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. EYES: Immediately flush with running water for at least 15 minutes; hold upper and lower eyelids open occasionally. SKIN: Immediately flush skin with running water for at least 15 minutes. Speed in removing material from skin is extremely important. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature. INGESTION: If swallowed and victim is unconscious or having convulsions, do nothing except keep victim warm.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 670 mg/kg (mouse; rat)
5.7 **Late Toxicity:** It produced tumorigenic effects and reproductive effects. Rat toxicity studies showed marked injury to the kidneys, fatty infiltration of the liver, and hemorrhages in the intestines. Inhalation can cause liver and kidney damage.
5.8 **Vapor (Gas) Irritant Characteristics:** The vapors are irritating and toxic.
5.9 **Liquid or Solid Irritant Characteristics:** Strong irritant to tissue. Contact may cause burns to skin and eyes.
5.10 **Odor Threshold:** 0.019 mg/m³
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 147°F C.C.
6.2 **Flammable Limits in Air:** 1.7 % (calculated)
6.3 **Fire Extinguishing Agents:** Small fires: dry chemical, carbon dioxide, water spray or foam. Large Fires: Water spray, fog or foam.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Contain poisonous chloride fumes.
6.6 **Behavior in Fire:** Burns and produces toxic and irritating gases.
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Sodium bicarbonate
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 8.4 ppm/96hr/bluegill fingerlings/TL_m/fresh water (cold)
8.2 ppm/24hr/bluegill sunfish/TL_m/fresh water (warm water)
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Not listed
9.4 **Venting:** Not listed

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 128.56
12.3 **Boiling Point at 1 atm:** 346.1°F = 174.5°C = 447.7°K
12.4 **Freezing Point:** 48.7°F = 9.3°C = 282.5°K
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** 1.25 at 25°C
12.8 **Liquid Surface Tension:** 40.3 dynes/cm = 0.040 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** 4.5
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** 144.8 Btu/lb = 80.4 cal/g = 3.4 X 10^5 J/kg
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

CRH	o-CHLOROPHENOL

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
68	78.860		D		D	70	3.806
70	78.780		A		A	75	3.625
72	78.700		T		T	80	3.444
74	78.620		A		A	85	3.263
76	78.540					90	3.082
78	78.460		N		N	95	2.901
80	78.380		O		O	100	2.720
82	78.300		T		T	105	2.539
84	78.220					110	2.359
86	78.140		A		A		
			V		V		
			A		A		
			I		I		
			L		L		
			A		A		
			B		B		
			L		L		
			E		E		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	2.850	75	0.042	20	0.00070		D
		100	0.115	40	0.00343		A
		125	0.252	60	0.00868		T
		150	0.478	80	0.01675		A
		175	0.821	100	0.02791		
		200	1.312	120	0.04234		N
		225	1.984	140	0.06023		O
		250	2.871				T
		275	4.012				
		300	5.445				A
							V
							A
							I
							L
							A
							B
							L
							E

OILS, MISCELLANEOUS: TRANSFORMER

OTF

Common Synonyms	Oily liquid	Colorless to light brown	Motor oil-like odor
Insulating oil Electrical insulating oil Petroleum insulating oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with foam, dry chemical, carbon dioxide.
Water may be ineffective on fire.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.

Remove contaminated clothing.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** Not applicable
3.3 **IMO/UN Designation:** 3.3/1270
3.4 **DOT ID No.:** 1270
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless to light brown
4.3 **Odor:** Like motor oil

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective gloves; goggles or face shield.
5.2 **Symptoms Following Exposure:** Ingestion of liquid may irritate stomach and cause increased frequency of bowel movements. If taken into lungs, delayed pulmonary irritation may occur.
5.3 **Treatment of Exposure:** INGESTION: do NOT induce vomiting. ASPIRATION: check for delayed irritation by serial X-rays. EYES: wash with copious amounts of water. SKIN: wipe off and wash with soap and water.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 1; LD_{50} = 5 to 15 g/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 295°F O.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** −75°F = −59°C = 214°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 0.891 at 15°C (liquid)
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** 49 dynes/cm = 0.049 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

OILS, MISCELLANEOUS: TRANSFORMER

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	55.560
52	55.560
54	55.560
56	55.560
58	55.560
60	55.560
62	55.560
64	55.560
66	55.560
68	55.560
70	55.560
72	55.560
74	55.560
76	55.560
78	55.560
80	55.560
82	55.560
84	55.560

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
50	.463
52	.463
54	.463
56	.463
58	.463
60	.463
62	.463
64	.463
66	.463
68	.463
70	.463
72	.463
74	.463
76	.463
78	.463
80	.463
82	.463
84	.463
86	.463
88	.463
90	.463
92	.463
94	.463
96	.463
98	.463
100	.463

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
65	.790
70	.790
75	.790
80	.790
85	.790
90	.790
95	.790
100	.790
105	.790
110	.790
115	.790
120	.790
125	.790
130	.790
135	.790

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
100.42	10.250

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch (estimate)
70	.042
75	.049
80	.057
85	.065
90	.076
95	.087
100	.100
105	.114
110	.131
115	.149
120	.170
125	.193
130	.218
135	.247
140	.279
145	.314
150	.352
155	.395
160	.443
165	.495
170	.552
175	.615
180	.683
185	.758
190	.841
195	.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, MISCELLANEOUS: MOTOR

OMT

Common Synonyms	Oily liquid	Yellow-brown	Lube oil odor
Crankcase oil Lubricating oil Transmission oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shorelins.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** Not applicable
3.3 **IMO/UN Designation:** 3.3/1270
3.4 **DOT ID No.:** 1270
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Yellow fluorescent
4.3 **Odor:** Characteristic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective gloves; goggles or face shield.
5.2 **Symptoms Following Exposure:** INGESTION: minimal gastrointestinal irritation; increased frequency of bowel passage may occur. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 **Treatment of Exposure:** INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays. EYES: wash with copious amounts of water. SKIN: wipe off oil and wash with soap and water.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 1; LD_{50} = 5 to 15 g/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 275—600°F C.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 325—625°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Various viscosities
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** —29.9°F = —34.4°C = 238.8°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 0.84—0.96 at 15°C (liquid)
12.8 **Liquid Surface Tension:** 36-37.5 dynes/cm = 0.036—0.0375 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 33—54 dynes/cm = 0.033—0.054 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** —18,486 Btu/lb = —10,270 cal/g = —429.96 X 10^3 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

OILS, MISCELLANEOUS: MOTOR

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	52.430
52	52.430
54	52.430
56	52.430
58	52.430
60	52.430
62	52.430
64	52.430
66	52.430
68	52.430
70	52.430
72	52.430
74	52.430
76	52.430
78	52.430
80	52.430
82	52.430
84	52.430

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
50	.460
52	.461
54	.462
56	.463
58	.464
60	.465
62	.466
64	.467
66	.468
68	.469
70	.470
72	.471
74	.472
76	.473
78	.474
80	.475
82	.476
84	.477
86	.478
88	.479
90	.480
92	.481
94	.482
96	.483
98	.484
100	.485

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)
35	.920
40	.919
45	.918
50	.917
55	.916
60	.915
65	.914
70	.913
75	.912
80	.911
85	.910
90	.909
95	.908
100	.907
105	.906
110	.905
115	.904
120	.903

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
100.42	275.000

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch (estimate)
70	.042
75	.049
80	.057
85	.065
90	.076
95	.087
100	.100
105	.114
110	.131
115	.149
120	.170
125	.193
130	.218
135	.247
140	.279
145	.314
150	.352
155	.395
160	.443
165	.495
170	.552
175	.615
180	.683
185	.758
190	.841
195	.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, MISCELLANEOUS: MINERAL

OMN

Common Synonyms	Oily liquid	Colorless	Odorless
White oil Liquid Petrolatum	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** Not applicable
3.3 **IMO/UN Designation:** 3.3/1270
3.4 **DOT ID No.:** 1270
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Very faint

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Goggles or face shield.
5.2 **Symptoms Following Exposure:** Ingestion of liquid can cause very loose bowel movements.
5.3 **Treatment of Exposure:** EYES: wash with water.
5.4 **Threshold Limit Value:** 5 mg/m³ (mist)
5.5 **Short Term Inhalation Limits:** Not pertinent
5.6 **Toxicity by Ingestion:** Grade 1; LD_{50} = 5 to 15 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** None
5.9 **Liquid or Solid Irritant Characteristics:** None
5.10 **Odor Threshold:** Not pertinent
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 380°F O.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water or foam may cause frothing.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 500—700°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial; refined
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 0.822 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 27 dynes/cm = 0.027 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 47 dynes/cm = 0.047 N/m at 70°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

OILS, MISCELLANEOUS: MINERAL

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
50	51.190	65	.487	65	.907	100.42	38.000
52	51.190	70	.487	70	.905		
54	51.190	75	.487	75	.903		
56	51.190	80	.487	80	.901		
58	51.190	85	.487	85	.898		
60	51.190	90	.487	90	.896		
62	51.190	95	.487	95	.894		
64	51.190	100	.487	100	.892		
66	51.190	105	.487	105	.889		
68	51.190	110	.487	110	.887		
70	51.190	115	.487	115	.885		
72	51.190	120	.487	120	.883		
74	51.190	125	.487	125	.880		
76	51.190	130	.487	130	.878		
78	51.190	135	.487	135	.876		
80	51.190	140	.487	140	.874		
82	51.190	145	.487	145	.871		
84	51.190	150	.487	150	.869		
		155	.487	155	.867		
		160	.487	160	.865		
		165	.487	165	.862		
		170	.487	170	.860		
		175	.487	175	.858		
		180	.487	180	.856		
		185	.487	185	.853		
		190	.487				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch (estimate)	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	70	.042		N		N
	N	75	.049		O		O
	S	80	.057		T		T
	O	85	.065				
	L	90	.076		P		P
	U	95	.087		E		E
	B	100	.100		R		R
	L	105	.114		T		T
	E	110	.131		I		I
		115	.149		N		N
		120	.170		E		E
		125	.193		N		N
		130	.218		T		T
		135	.247				
		140	.279				
		145	.314				
		150	.352				
		155	.395				
		160	.443				
		165	.495				
		170	.552				
		175	.615				
		180	.683				
		185	.758				
		190	.841				
		195	.930				

4.0 SITE CONTROL

4.1 ZONATION. The general zonation protocols that should be employed at hazardous waste sites are described in Appendix G. The site-specific zonation that will be used for activities during this project are described as follows:

- geophysical survey, a non-invasive activity that will not require zonation control;
- drilling and well installation, an exclusion zone will be clearly defined as a taped-off area and a contamination reduction zone (CRZ) and support zone will be established;
- test pit excavation, an exclusion zone will be defined as the area within 10 feet of the backhoe, test pit, and spoils pile; and
- TerraProbe℠, groundwater, and surface water and sediment sampling will not require zonation.

4.2 COMMUNICATIONS. The field office will be equipped with a radio communications base station and a telephone. All field teams will be provided with a mobile hand-held radio to facilitate onsite communications. In addition, a portable mobile cellular telephone will be available in at least one onsite field vehicle. When radio communication is not used, the following air horn signals will be employed:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(_ _ _)
ALL CLEAR	alternating long and short blasts	(_ . _ .)

4.3 WORK PRACTICES. General work practices to be used during ABB-ES projects are described in Appendix H. Specific work practices necessary for this project or those that are of significant concern are described as follows.

- Both onsite and offsite activities will take place in an active industrial area. Care will be taken to clear utilities, avoid overhead lines, and set up safety cones or barriers when working in heavily traveled lanes.
- The drilling contractor will have documented safety and emergency action procedures for the equipment to be operated. The drilling contractor's employees will acknowledge in writing that they have read and understand these procedures.
- The drilling contractor will ensure that the equipment is well maintained, meets safety requirements, is inspected daily during use, and has all required safety equipment, i.e., 20-pound A:B:C fire

extinguisher, emergency stops, etc. Boring tools will be in good condition and will be adequate for the work to be performed.

- The drilling rig will be operated by a qualified operator who can identify pending failures and supervise the driller's helper(s). Transportation of the drill rig to the work site will be performed by a person with the proper commercial license.

- To the extent possible, the terrain should be level and the condition of the ground such that unexpected movement of the drill rig is unlikely. If the slope of the terrain is hazardous, the project manager or technical lead and the Navy will be contacted for the selection of a safe drilling site.

- ABB-ES personnel and subcontractors will comply with the State, local, and installation motor vehicle laws and regulations. Special circumstances such as current and anticipated hazardous road conditions will be addressed at safety briefings.

5.0 DECONTAMINATION AND DISPOSAL

All personnel and/or equipment leaving contaminated areas of the POI will be subject to decontamination, which will take place in the Contamination Reduction Zone (CRZ). General personnel and equipment decontamination practices used during ABB-ES projects are described in Appendix L, and detailed equipment decontamination procedures are addressed in Volume I, Section 4.3 of this document.

5.1 PERSONNEL DECONTAMINATION. All personnel will follow standard decontamination practices when leaving hazardous waste POI, including proper decontamination, and removal and disposal of personal protective equipment and tools. Personal protection levels for decontamination will correspond with the level of protection used during the field activity.

5.2 SMALL EQUIPMENT DECONTAMINATION. Small equipment will be protected from contamination as much as possible by keeping the equipment covered when at the site and placing the equipment on plastic sheeting, not the ground. Sampling equipment used at the site will be used only once or will be field cleaned between sampling.

5.3 HEAVY EQUIPMENT DECONTAMINATION. Drilling rigs and other heavy equipment will be cleaned with high-pressure water or steam, followed by a soap and water wash and rinse. Loose material will be removed with a brush. Downhole tools and heavy equipment will be decontaminated in accordance with Volume I, Section 4.3 of this document.

A decontamination pit will be constructed downwind of the POI to allow collection of decontamination fluids.

5.4 DISPOSAL OF CONTAMINATED MATERIALS. Investigation derived wastes will be collected, screened, and stored or disposed. In general, discarded materials, waste materials, or other objects will be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left onsite. Potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary and segregated for disposal. If radioactive waste or contamination is encountered in the contaminated materials, the wastes generated from work activities will be handled as low-level radioactive waste unless proven otherwise. Contaminated waste materials will be disposed as required by provisions included in the contract and consistent with NTC, Orlando and regulatory provisions. All non-contaminated materials will be collected and bagged for appropriate disposal as normal domestic waste.

Further details can be found in Volume I, Section 4.10 of this document.

6.0 EMERGENCY AND CONTINGENCY PLAN

This chapter identifies emergency and contingency planning that has been undertaken for operations at this site. Most sections of the HASP provide information that would be used under emergency conditions. General emergency planning information is addressed in Appendix M. The following sections present site-specific emergency and contingency planning information.

6.1 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION. The site HSO is the primary authority for directing operations at the site under emergency conditions. All communications both onsite and offsite will be directed through the HSO.

6.2 EVACUATION. At NTC, Orlando, severe hazard conditions are not anticipated. However, in the event that abnormal levels of toxic gases are encountered, the following evacuation measures have been established.

In the event of an emergency situation such as fire, explosion, significant release of toxic gases, etc., an air horn or other appropriate device will be sounded for three long blasts indicating the initiation of evacuation procedures. All personnel will evacuate the work area. The location of safe areas will be upwind of the POI. For efficient and safe site evacuation and assessment of the emergency situation, the HSO will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The HSO must see that access for emergency equipment is provided and that all combustible apparatus have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the proper NTC, Orlando officials will be notified by telephone of the emergency.

The HSO will notify local fire and police departments, and other appropriate emergency responders, if LEL values are above established action levels in the work zone, or if an actual fire or explosion has taken place.

6.3 EMERGENCY MEDICAL TREATMENT AND FIRST AID. Any personnel injured onsite will be rendered first aid as appropriate and transported to competent medical facilities for further examination and/or treatment. The preferred method of transport is through professional emergency transportation means; however, when this is not readily available or would result in excessive delay, other transport will be authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

When an injury occurs in the exclusion zone, provisions for decontamination of the victim will be made. However, life-threatening conditions may preclude normal decontamination procedures. In such cases, arrangements will be made with the medical facility and transporter to provide for the situation.

The following is a list of personnel who will be onsite and trained to render first aid and CPR:

Team Member	Responsibility	Training
FOL	Manage daily site operations	CPR and First Aid
Task Leader	Health and Safety Officer	CPR and First Aid

7.0 OTHER

7.1 ILLUMINATION. Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light meeting the 5-foot candle requirement of 29 CFR 1910.120, operations must halt in time to permit personnel and equipment to exit the Exclusion Zone and proceed through decontamination during adequate daylight. Conversely, operations will not be permitted to begin until adequate lighting is present.

7.2 EXCAVATION. Site excavations created during site operations will be shored or sloped to prevent accidental collapse and otherwise conducted in accordance with Subpart P of 29 CFR 1926, as summarized in Appendix J. Under no circumstances will site personnel enter excavations that are not adequately shored or sloped. Where entry into an excavation does occur and it would even remotely be considered a confined space, such an entry will be made in accordance with the confined space entry program addressed in Section 7.3 and under provision of Appendix I.

7.3 CONFINED SPACE ENTRY. Confined space entry presents special problems and substantial risks to personnel that would be involved directly in the entry and those that might be called on to attempt a rescue of the initial entrants. Therefore, entry into a confined space is a MEANS OF LAST RESORT, and will only be permitted where no other mechanism is feasible to achieve the desired goal. If confined space entry is required, entry will be conducted under provisions of Appendix I.

8.0 ADMINISTRATION

8.1 PERSONNEL AUTHORIZED DOWNRANGE. Personnel authorized to participate in exclusion zone activities at NTC, Orlando have been reviewed and certified for site operations by the TOM and the HSM. Certification involves the completion of appropriate training, a medical examination, and a review of this site-specific HASP. All persons entering the site must use the buddy system and check in with the Site Manager and/or HSO before going into the exclusion zone.

8.2 HEALTH AND SAFETY PLAN (HASP) APPROVALS. By their signatures, the undersigned certify that this HASP will be used for the protection of the health and safety of all persons entering this site.

James L. Manning — 7/20/94
James Manning, Task Order Manager — Date

My MacLeod Health + Safety Supervisor — 7-19-94
Cynthia Sundquist, ABB-ES Health and Safety Manager — Date
Signing For:

8.3 FIELD TEAM REVIEW

I have read and reviewed the health and safety information in the HASP. I understand the information and will comply with the requirements of the HASP.

Name	Date

Name	Date

8.4 MEDICAL DATA SHEET. This Medical Data Sheet will be completed by all onsite personnel and will be kept in the Support Zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with the ABB-ES Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more space is required, use the back of this sheet.

Project: NTC, Orlando

Name: _____

Address: _____

Home Telephone: Area Code ( ) _____

Age: __ Height: _____ Weight: ___

In case of emergency, contact: _____

Address: _____

Telephone: Area Code ( ) _____

Do you wear contact lenses? Yes ( ) No ( )

Allergies: _____

List medication(s) taken regularly: _____

Particular sensitivities: _____

Previous/current medical conditions or exposures to hazardous chemicals: _____

_____

Name of Personal Physician: _____

Telephone: Area Code ( ) _____

8.5 EMERGENCY TELEPHONE NUMBERS

Orlando Police Department	911
Main Base Police Emergency	(407) 646-4444
Rescue Service	911
Main Base Naval Hospital	(407) 646-4911
Primary Hospital	
Main Base (Winter Park Memorial Hospital	(407) 646-7320
Area "C" (Florida Hospital	(407) 897-1940
Herndon Annex (Orlando General Hospital	(407) 275-5150
McCoy Annex (Orlando Regional Medical Center)	(407) 841-5111
Alternate Hospital	
Main Base and Herndon Annex (Florida Hospital)	(407) 897-1940
Area "C" (Winter Park Memorial Hospital)	(407) 646-7320
McCoy Annex	None
Fire Department	
Main Base	(407) 646-4333
General	911
Offsite Emergency Services	911
Poison Control Center	(800) 962-1253
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(904) 488-1554
NTC, Orlando Officer of the Day	(407) 646-4501
Site HSO: To be determined	( ) -
Site FOL: Gerry Girardot	(904) 269-7012
Task Order Manager: James Manning	(904) 269-7012
Project HSS: To be determined	( ) -
ABB-ES HSM: C.E. Sundquist	(207) 775-5401 x3309

8.6 ROUTES TO EMERGENCY MEDICAL FACILITIES In the event of a life-threatening situation, the Naval Hospital on the Main Base will provide care. For less critical situations, or if medical assistance is required at other than the Main Base, the following sources of medical assistance apply. The NTC, Orlando Officer of the Day must be informed of any incident or accident that requires medical attention as soon as possible.

The primary source of medical assistance for Main Base is:

Facility Name: Winter Park Memorial Hospital

Address: 200 Lakemont Avenue, Winter Park, FL

Telephone Number: (407) 646-7000; Emergency (407) 646-7320

Directions to primary source of medical assistance from Main Base (Figure 8-1):

From project site leave Main Base going north through the North Gate. Continue north on Lakemont Avenue for about 1.7 miles. The hospital is on the right between the intersections of Mizell Avenue and Aloma Avenue.

The primary source of medical assistance for Area "C" is:

Facility Name: Florida Hospital

Address: 601 E. Rollins Street, Orlando, FL

Telephone Number: (407) 896-6611; Emergency (407) 897-1940

Directions to primary source of medical assistance from Area "C" (Figure 8-1):

From project site leave Area "C" and turn right onto Maguire. Continue to Colonial Drive (SR 50). Turn right (west) and continue to Mills Avenue (Highway 17/92). Turn right (north) to Rollins Street. The Florida Hospital is on the left (west) side of Mills Avenue, at the intersection with Rollins Street.

The primary source of medical assistance for Herndon Annex is:

Facility Name: Orlando General Hospital

Address: 7727 Lake Underhill Road, Orlando, FL

Telephone Number: (407 277-8110; Emergency (407) 275-5150

Directions to primary source of medical assistance from Herndon Annex (Figure 8-1):

From project site leave Herndon Annex going east on Kalmia to Semoran Boulevard. Take a right (south) at Semoran Boulevard. Continue to the Lake Underhill Road intersection and turn left (east, just past the East-West Expressway overpass). Continue for about 1.8 miles to the hospital on the

left, which is between the intersections of Goldenrod Road and Chickasaw Trail.

The primary source of medical assistance for McCoy Annex is:

Facility Name: Orlando Regional Medical Center

Address: 1414 Kuhl Avenue, Orlando, FL

Telephone Number: (407) 841-5111; Emergency (407) 841-5111

Directions to primary source of medical assistance from McCoy Annex (Figure 8-2):

From project site leave McCoy Annex through the north Daetwyler Drive entrance. Turn left (west) on the frontage road (McCoy Road) along the Bee-Line Expressway and continue to the South Orange Avenue intersection. Turn right (north) and continue for about 5.4 miles to the hospital on the left, which is between the side roads of Sturtevant and Underwood Streets. Kuhl Avenue is behind the hospital.

Alternate source of medical assistance for Main Base and Herndon Annex is:

Facility Name: Florida Hospital

Address: 601 E. Rollins Street, Orlando, FL

Telephone Number: (407) 896-6611; Emergency (407) 897-1940

Directions to alternate source of medical assistance from Main Base (Figure 8-3):

From project site leave Main Base through the Maguire Gate. Continue on Maguire Boulevard to the Colonial Drive (SR 50) intersection. Turn right (west) and continue to the Mills Avenue intersection. Turn right (north) and continue about 1.4 miles to Rollins Street. The hospital is on the left (west).

Directions to alternate source of medical assistance from Herndon Annex (Figure 8-3):

From project site leave Herndon Annex going east on Kalmia. Take a left (north) onto Semoran Boulevard (SR 436) and continue to the Colonial Drive (SR 50) intersection. Turn left (west) and continue to the Mills Avenue intersection. Turn right (north) and continue about 1.4 miles to Rollins Street. The hospital is on the left (west).

The alternate source of medical assistance for Area "C" is:

Facility Name: Winter park Memorial Hospital

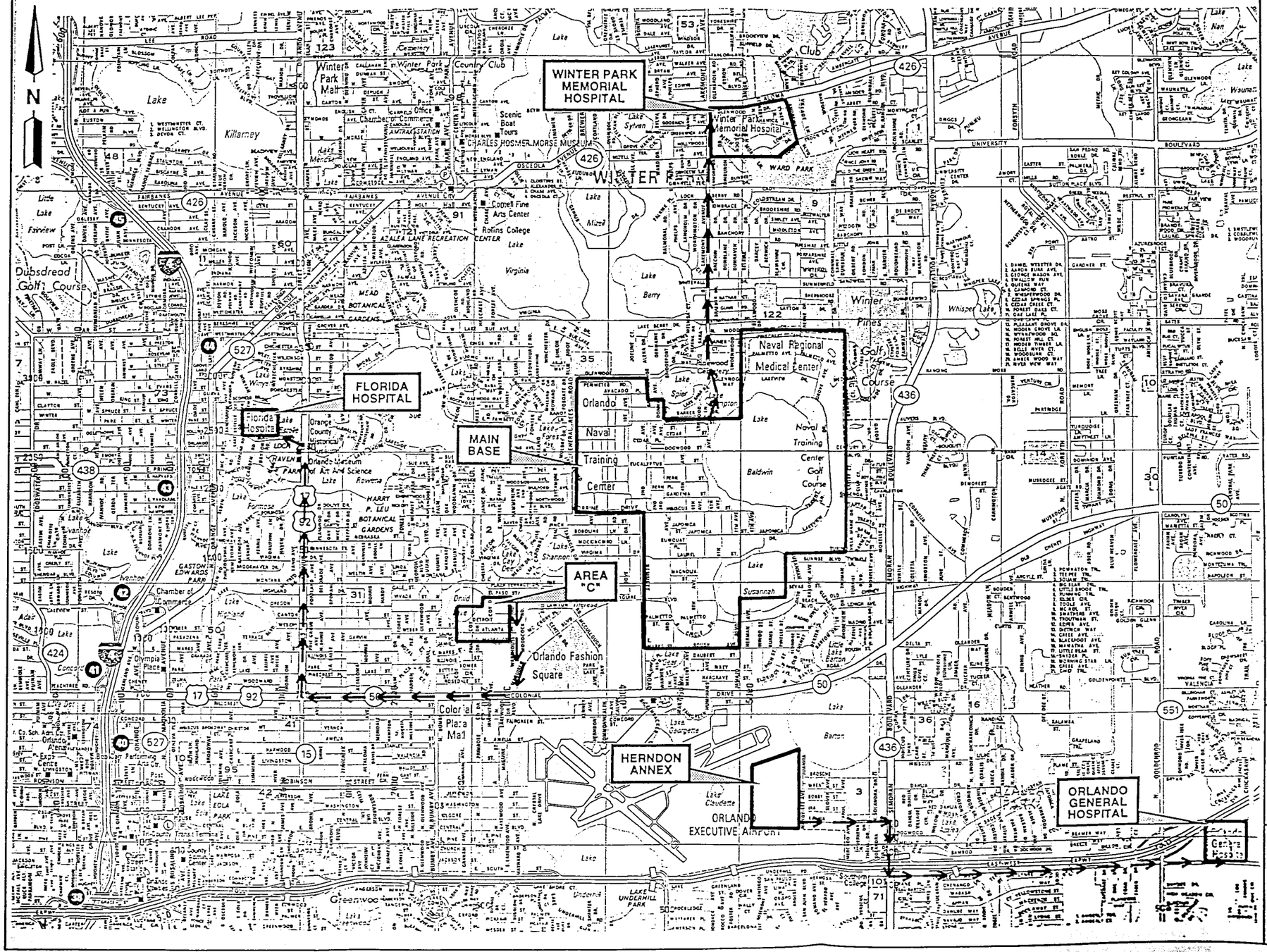
Address: 200 Lakemont Avenue, Winter Park, FL

Telephone Number: (407) 646-7000; Emergency (407) 646-7320

Directions to alternate source of medical assistance from Area "C" (Figure A-3):

From project site leave Area C and turn right onto Maguire. Continue to the Colonial drive (SR 50) intersection. Turn left (east) and continue until the Bennet Road intersection. Turn left (north) and continue until Corrine Drive and turn left (west). Continue on Corrine Drive and turn right (east) at Glenridge Way. Follow Glenridge and turn left (north) at Lakemont Avenue. Continue north on Lakemont Avenue for about 1.7 miles. The hospital is on the right between the intersections of Mizell Avenue and Aloma Avenue.

There is no alternate source of medical assistance for McCoy Annex within 10 miles.



SOURCE: AAA MAP OF ORLANDO, FLORIDA, 1994-1995 EDITION.

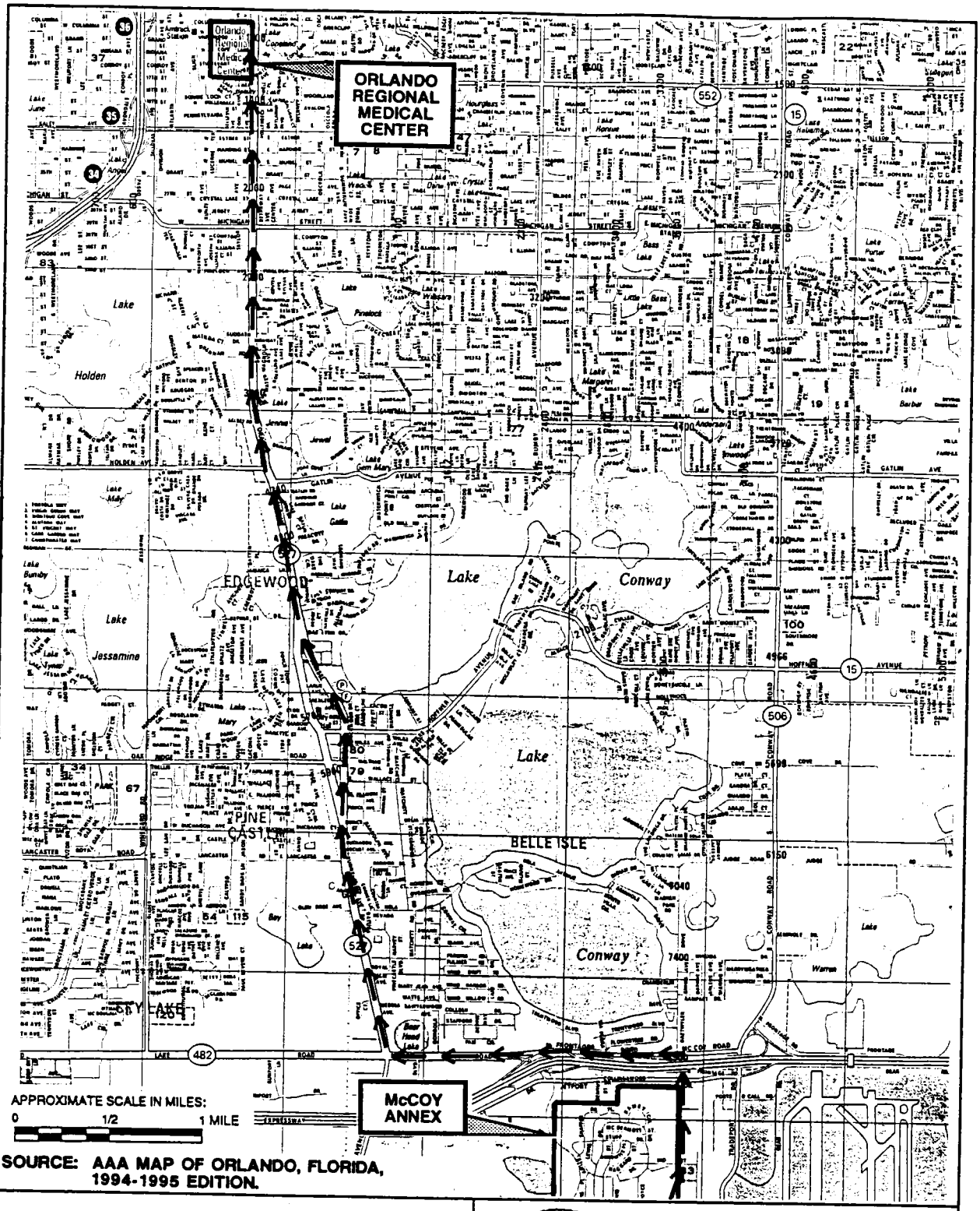
FIGURE 8-1

MAIN BASE, AREA "C", AND HERNDON ANNEX
PRIMARY HOSPITAL ROUTES

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-23 940708WEM



SOURCE: AAA MAP OF ORLANDO, FLORIDA, 1994-1995 EDITION.

FIGURE 8-2

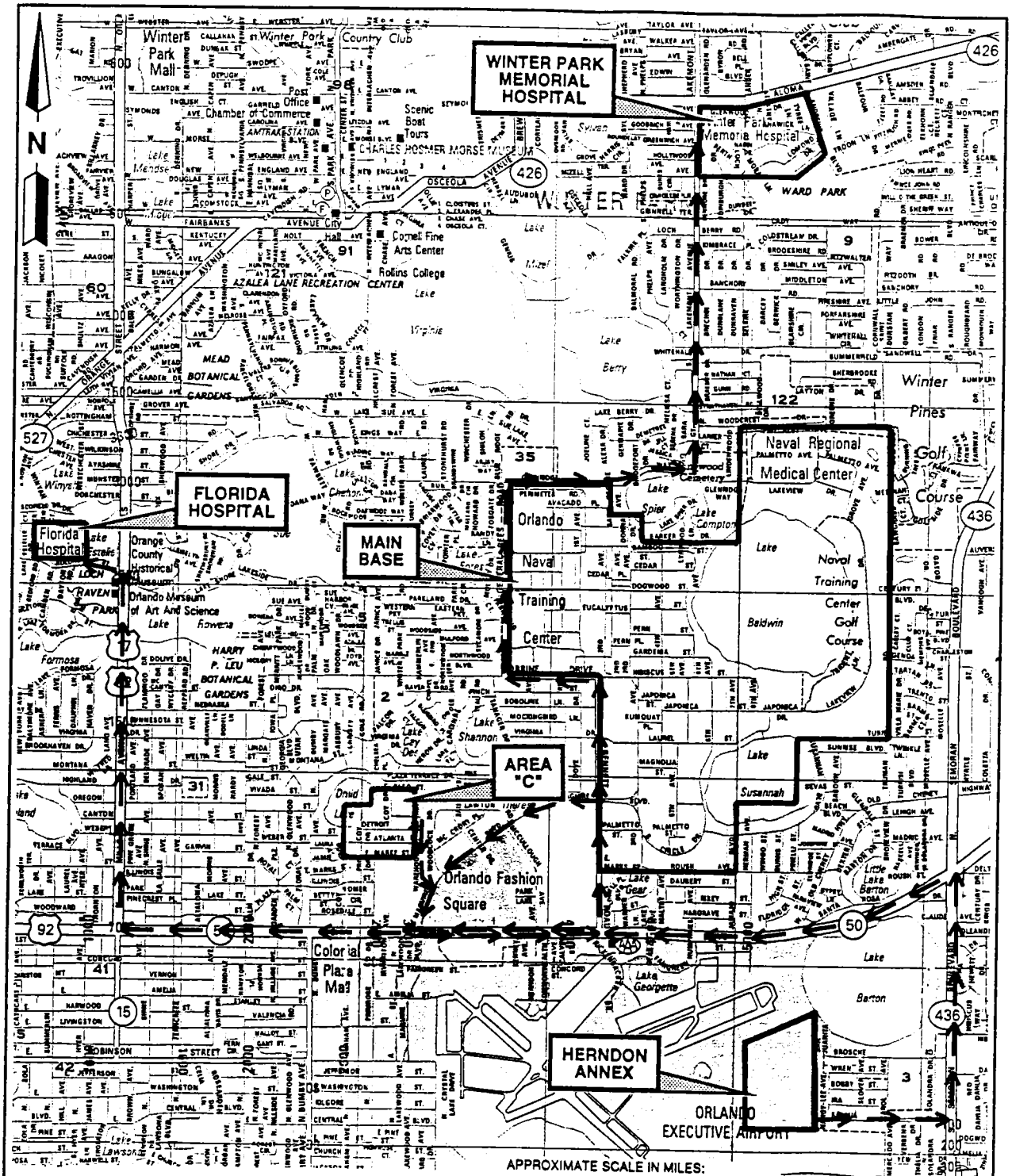
McCOY ANNEX
PRIMARY HOSPITAL ROUTE

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-23 940707WEM

NTC_Orl.HSP
MVL.07.94



SOURCE: AAA MAP OF ORLANDO, FLORIDA, 1994-1995 EDITION.

FIGURE 8-3

MAIN BASE, AREA "C", AND HERNDON ANNEX SECONDARY HOSPITAL ROUTES

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

8519-23 940707WEM
NTC_Orl.HSP
MVL.07.94

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ATTACHMENT A

GENERIC HEALTH AND SAFETY PLAN

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Generic Health and Safety Plan
NTC, Orlando, Orlando, Florida

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APPENDIX A
AUTHORITY AND RESPONSIBILITY OF HEALTH AND SAFETY PERSONNEL

APPENDIX A AUTHORITY AND RESPONSIBILITY OF HEALTH AND SAFETY PERSONNEL

This section describes the health and safety designations and general responsibilities that will be employed for the project.

A.1 HEALTH AND SAFETY MANAGER

The Health and Safety Manager (HSM), ABB Environmental Services, Inc. (ABB-ES), can be reached by telephone at (207) 775-5401 in Portland, Maine. The HSM has final authority over health and safety issues that are not resolved at the site or through the Health and Safety Supervisor (HSS), and has overall responsibility for ensuring that the policies and procedures of this Health and Safety Plan (HASP) are implemented by the Health and Safety Officer (HSO). In the various regions, the HSM may delegate additional functions to the Regional HSS.

A.2 HEALTH AND SAFETY SUPERVISOR

The HSS is the health and safety professional serving as the ABB-ES HSM's designee for this project. As such, the HSS will be responsible for (1) approval of the individual chosen to serve as the site HSO for this field operation; (2) review and approval of site-specific HASPs developed by the HSO, as well as any significant changes made over time to the site HASP; (3) oversight of the daily efforts of the HSO; (4) resolution of site disputes involving health and safety issues; and (5) implementation of the HASP by the HSO. The HSS will notify the HSM of any Stop Work Orders issued by an HSO.

APPENDIX B TRAINING PROGRAM

APPENDIX B TRAINING PROGRAM

All personnel working on an ABB-ES site who potentially may be exposed to toxic substances or hazardous materials will participate in an initial and an annual refresher and/or supervisory training (as appropriate), as well as site-specific training before commencement of the on-site assignment. The initial Health and Safety Training Program consists of the 40-hour training program required and designated by the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.120. In addition to the initial training, ABB-ES uses 8-hour annual refresher and supervisory training elements, which are augmented by site-specific training regarding site hazards and specialized problems and protocols.

B.1 INITIAL TRAINING

All site-assigned personnel who are potentially exposed to toxic substances or hazardous materials will be required to participate in a training course on hazardous waste site operations. This training is required under provisions of the OSHA standard, and must consist of 40 hours covering the following areas:

- familiarity with the regulations and implications of OSHA regulations in 29 CFR 1910.120
- familiarity with the organizational structure responsible for site health and safety
- explanation of the medial surveillance requirements, including recognition of health hazards
- instruction in the use and maintenance of personal protective equipment
- identification and analysis of site chemical and physical hazards
- instruction regarding monitoring equipment, including personnel and environmental sampling instruments
- site control and decontamination procedures
- contingency planning
- confined-space entry procedures

B.2 ANNUAL REFRESHER/SUPERVISORY TRAINING

Annually, all personnel required to participate in the initial training will take an 8-hour refresher training course. Those personnel with either site supervisory or health and safety responsibilities will also have an additional 8 hours of training beyond the initial 40 hours. The 8-hour supervisory training meets requirements of the annual refresher.

B.3 SITE-SPECIFIC TRAINING

All personnel assigned to an ABB-ES site must participate in the site-specific training presentation, which will cover major elements of the site HASP, as well as health and safety procedures regarding an individual's specific job responsibilities and tasks. The site HSO or health and safety designee will provide this training before an individual is permitted to work in a downrange position.

B.4 OTHER TRAINING

Additional training will be provided as determined by the HSM or the HSS, and may include additional refreshers on personal protective equipment, instrumentation, CPR, first aid, or any other pertinent health- or safety-related subject.

APPENDIX C MEDICAL SURVEILLANCE PROGRAM

APPENDIX C MEDICAL SURVEILLANCE PROGRAM

C.1 HEALTH MONITORING PROGRAM

All on-site ABB-ES personnel and laboratory staff must be enrolled in the Health Monitoring Program, which is implemented through Environmental Medicine Resources, Inc., a company consisting of a team of physicians and support personnel who specialize in occupational medicine. The health monitoring program consists of an initial medical examination to establish the employee's general health profile, which provides important baseline laboratory data for later comparative study and annual examinations. The contents of the initial comprehensive physical examination and laboratory testing routine are listed in Table C-1. Follow-up examinations are completed annually for all personnel enrolled in the health monitoring program, or more frequently if project assignments warrant testing following specific field activities.

C.2 REVIEW OF EXPOSURE SYMPTOMS

Symptoms of exposure to hazardous materials will be reviewed for each site to indicate to personnel the recognized signs of possible exposure to those materials. This information will be supplemented with a discussion of the need for objectivity in the personal health assessment to account for normal reaction to stressful situations. The HSO will watch for outward evidence of changes in worker health. Symptoms may include skin irritations, skin discoloration, eye irritation, muscular soreness, fatigue, nervousness or irritability, intolerance to heat or cold, or loss of appetite. Employees will routinely be asked to assess their general state of health during the project. Special medical monitoring may be identified for certain sites.

TABLE C-1
BASELINE HEALTH MONITORING PROGRAM

PHYSICAL EXAMINATION

- medical history
- medical examination
- vision: - ~near/distant
  - ~color
- audiometry
- radiology: PA/LAT
- spirometry
- electrocardiogram

LABORATORY ANALYSIS

Complete Blood Counts and Chemistries

- white blood count
- differential cell counts
- methemoglobin
- uric acid
- lactic dehydrogenase
- alkaline phosphatase
- calcium
- phosphorus
- cholesterol
- urea nitrogen
- glucose
- albumin
- globulin
- total protein
- total bilirubin
- serum glutamic oxalacetic transaminase
- hemoglobin and/or hematocrit

Urine Analysis

- color and character
- specific gravity
- pH
- protein
- acetone
- glucose
- microscopic examination

Biotox Panel

APPENDIX D ENGINEERING CONTROLS

APPENDIX D ENGINEERING CONTROLS

Whenever feasible, engineering controls will be used at the site to reduce employee exposure to hazardous substances. Feasible engineering controls include the following:

- the use of pressurized cabs or control booths
- the use of remotely operated materials-handling equipment
- the use of industrial-sized fans to blow hazardous vapors from the breathing zone when exposure is from a point source and a power source is available

APPENDIX E PERSONAL PROTECTIVE EQUIPMENT

APPENDIX E PERSONAL PROTECTIVE EQUIPMENT

E.1 PERSONAL PROTECTION LEVEL DETERMINATION

The level of personal protective equipment required will be determined by the type and levels of waste or spill material present at the site where project personnel may be exposed. In situations where the types of waste or spill material on-site are unknown, the hazards are not clearly established, or the situation changes during on-site activities, the HSO must make a reasonable determination of the level of protection that will ensure the safety of investigators and response personnel until potential hazards have been determined through monitoring, sampling, informational assessment, laboratory analyses, or other reliable methods. Once the hazards have been determined, protective levels commensurate with the hazards will be used. Protection requirements will be evaluated on a continuous basis to reflect new information as it is acquired.

E.2 LEVELS OF PROTECTION

The following subsections describe the basic composition of the generally recognized protective ensembles to be used for site operations. Specific components for any level of protection will be selected based on hazard assessment; additional elements will be added as necessary. Disposable protective clothing, gloves, and other equipment, exclusive of respirators, should be used when feasible to minimize risks during decontamination and possible cross-contamination during sample handling.

E.2.1 Level A

Level A protection provides the highest level of protection for skin, eyes, and the respiratory system. It is appropriate for conditions where there are potential or actual high concentrations of atmospheric vapors, gases, or particulates. Level A should be used if site operations or work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to the skin or capable of being absorbed through the intact skin. Level A is used primarily for emergency situations or when the following conditions exist: (1) vapors or mists of strong acids; (2) known or probable immediately dangerous to life and health (IDLH) atmospheres with dermally active compounds; (3) high atmospheric concentrations of compounds that can be absorbed through the skin; and (4) operations that must be conducted in a confined, poorly ventilated area, where conditions requiring Level A have not yet been eliminated. The fully encapsulating suit and the pressure-demand self-contained breathing apparatus (SCBA) or hoseline respirator are the key elements in Level A personal protective equipment (PPE).

Level A equipment includes the following items:

- SCBA (pressure demand) OR supplied air respirator (pressure demand with escape mask)
- total encapsulating suit
- coveralls (optional)

- long underwear
- gloves (outer, chemical-resistant)
- gloves (inner, chemical-resistant)
- boots (chemical-resistant, steel-toed, steel shank)
- hardhat (optional)
- disposable protective suit, gloves, and boots (to be worn over or under encapsulating suit)
- two-way radios

E.2.2 Level B

Level B protection should be used when the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection; however, the atmospheric contaminant, splashing liquid, or other direct contact will not adversely affect or be absorbed through any exposed skin. This includes atmospheres with IDLH concentrations of specific substances that do not (1) represent a severe skin hazard, or (2) meet the criteria for use of air-purifying respirators. Level B has the same respiratory protection criteria as Level A; however, dermal exposure is not as severe.

Level B equipment includes the following items:

- SCBA (pressure demand) OR supplied air respirator (pressure demand with escape SCBA)
- hooded chemical-resistant clothing (coated Tyvek)
- coveralls (optional)
- gloves (outer, chemical-resistant)
- gloves (inner, chemical-resistant)
- boots (chemical-resistant, steel-toed, steel shank)
- boot covers (chemical-resistant) (optional)
- hardhat (optional)
- two-way radio (to be worn under outside protective clothing)
- face shield (optional)

E.2.3 Level C

Level C protection should be used when the atmospheric contaminant, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin. In addition, the types of air contaminants must have been

identified, the concentration measured, and an air-purifying respirator must be available that can remove the contaminants. An air-purifying respirator can only be used if the oxygen content in the air is at least 19.5 percent, the contaminant has adequate warning properties (e.g., odor, taste, and irritating effect thresholds within two times the Threshold Limit Value), the concentration of the contaminant does not exceed the IDLH, and the worker has been fit-tested. Level C has the same splash protection as Level B; however, cartridge respirators are used instead of SCBAs.

Level C equipment includes the following items:

- full-face respirator (cartridge)
- hooded chemical-resistant clothing (coated Tyvek)
- coveralls (optional)
- gloves (inner, chemical-resistant)
- gloves (outer, chemical-resistant)
- boots (chemical-resistant, steel-toed, steel shank)
- boot covers (chemical-resistant) (optional)
- hardhat (optional)
- escape mask (optional)
- two-way radios (worn under outside protective clothing)
- face shield (optional)

E.2.4 Level D

Level D is a work uniform affording minimal protection and is used for nuisance contaminants only. Level D protection should only be used when the atmosphere contains no known hazard, all potential airborne contaminants can be monitored for, and work functions preclude splash, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemical.

Level D equipment includes the following items:

- coveralls
- gloves (optional)
- boots (chemical-resistant, steel-toed, steel shank)
- boot covers (chemical-resistant) (optional)
- safety glasses or chemical splash goggles (optional)
- hardhat (optional)
- escape mask (optional)
- face shield (optional)

APPENDIX F MONITORING EQUIPMENT

APPENDIX F MONITORING EQUIPMENT

The work environment will be monitored to ensure that IDLH or other dangerous conditions are identified. At a minimum, monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, hazardous concentrations of airborne contaminants, and radioactivity.

F.1 AIR SAMPLING: EQUIPMENT, CALIBRATION, AND MAINTENANCE

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading levels of protection, at the discretion of the site HSO.

F.1.1 ISC MX-241 Dual Detector

This meter monitors for combustible gases and oxygen. It can be used to determine (1) if an area contains concentrations of combustible gases with readings in percentage of the lower explosive limit (LEL); and (2) the percentage of oxygen. This equipment will be calibrated in accordance with the manufacturer's instructions.

This instrument also is calibrated to methane and monitors combustible gases in the percentage of the lower explosive limit. It will be calibrated in accordance with the manufacturer's instructions.

F.1.2 ISD HS267

This instrument monitors for the presence of hydrogen sulfide in parts per million (ppm). It will be calibrated in accordance with the manufacturer's instructions.

F.1.3 Photovac Organic Vapor Analyzer 10S50

The Organic Vapor Analyzer (OVA) is a total organic vapor analyzer capable of detecting volatile organic compounds (VOCs) that can be ionized by ultraviolet (UV) light. Model 10S50 is commonly used on-site to estimate the presence of VOCs for purposes of crew protection, well screen placement, and selection of samples for further analysis. The principle of operation is twofold: (1) the ambient temperature gas chromatograph, which breaks down mixtures of VOCs into individual components identified by retention time; and (2) detection accomplished by ionization in UV light. The charged component then moves to an electrode which, in turn, results in a meter deflection proportional to the concentration of the contaminant. This instrument does not read out directly in ppm unless calibrated against the material being measured; therefore, results must be interpreted conservatively and with care. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

F.1.4 HNU IS101, OVM Model 580A, and Photovac TIP Photoionization Detector

Like the OVA, the photoionization detector (PID) operates on the basis of ionization of the contaminant, which results in a meter deflection proportional to the concentration of the contaminant. In the PID, ionization is caused by a UV light source. The strength of the UV, measured in electron volts (eV), determines which contaminants can be ionized. The HNU can use three different-strength UV sources, including 9.6, 10.2, and 11.7 eV; only the 10.2- and 11.7-eV probes are currently available for field use. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

F.1.5 Detector Tubes (MSA and Draeger)

A colorimetric detector tube is a direct-reading instrument consisting of a glass tube impregnated with an indicating chemical, which is connected to a piston cylinder or bellows-type pump. A known volume of air is drawn through the glass tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional to the contaminant's concentration. Care must be taken when using the detector tubes because reliability of the results depends on the proper pump calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively affect measured results. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

F.2 PERSONAL MONITORING: EQUIPMENT, CALIBRATION, AND MAINTENANCE

Personal monitoring will be undertaken to characterize exposure of high-risk employees to hazardous substances encountered on-site.

F.2.1 Personal Sampling Pumps

These devices can be worn by an employee to draw air samples through appropriate collection media. The units can be used to draw volumes from 2 to 3 liters per minute. Calibration will be conducted using standard industrial hygiene protocols before and after each sampling session (i.e., each day's use).

F.2.2 Passive Dosimeters or Gas Badges

These devices are nonmechanical collection devices used to monitor for organic vapors and various gases. The device is worn by an employee and then sent to an industrial hygiene laboratory for analysis.

F.2.3 Thermoluminescent Dosimetry Body Badges

These devices are nonmechanical collection devices used to monitor for x-ray, beta, and gamma radiation exposure. The badges are worn by ABB-ES employees and sent quarterly to Tech/Ops Landauer, Inc., for analysis.

APPENDIX G ZONATION

APPENDIX G ZONATION

The site itself will normally be divided into three zones: (1) the majority of the work area, considered the Exclusion Zone; (2) limited areas serving as the Support Zone; and (3) an area for decontamination called the Contamination Reduction Zone (CRZ).

G.1 EXCLUSION ZONE

The Exclusion Zone isolates the area of contaminant generation and restricts (to the extent possible) the spread of contamination from active areas of the site to support areas and off-site locations. The Exclusion Zone is demarcated by the Hot Line (i.e., a tape line or physical barrier). Personnel entering the Exclusion Zone must (1) enter through the CRZ; (2) wear the prescribed level of protection; and (3) be otherwise authorized to enter the Exclusion Zone. Any personnel, equipment, or materials exiting the Exclusion Zone will be considered contaminated. Personnel will be subject to decontamination; equipment and materials will either be subject to decontamination or containerized in uncontaminated devices.

Within the Exclusion Zone, specific locations or restricted areas (clearly marked or identified) will be established (as necessary) for particular locations or around specific site operations. In the case of well drilling or excavation operations, a restricted area will be established that includes a minimum 30-foot radius from the drill rig or excavation operation. Other restricted areas may include drum areas, active site areas, sources of combustible gases or air contaminants, or other dangerous areas as they are identified. Access for emergency services to areas of specific site operations will be established.

G.2 CONTAMINATION REDUCTION ZONE

Moving out from the Exclusion Zone, starting at the Hot Line and continuing to the Contamination Control Line, is the CRZ. The CRZ is a transition zone between contaminated and uncontaminated areas of the site. When "hot" or contaminated personnel, equipment, or materials cross the Hot Line, they are assumed to be as hot or contaminated as they are going to be from site operations. Being subjected to the decontamination process, they become less contaminated; when they reach the Contamination Control Line, they are clean and can exit the CRZ without spreading contamination.

Within the CRZ is the Contamination Reduction Corridor, where materials necessary for full personnel and portable equipment decontamination are kept. A separate facility will be established for heavy equipment decontamination. In addition, certain safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) are staged in this zone.

G.3 SUPPORT ZONE

The Support Zone is the outermost zone of the site, separated from the CRZ by the Contamination Control Line; it is considered a clean area. Movement of personnel and materials from the Support Zone into the CRZ is generally unrestricted, except as required through access points controlled for administrative purposes. However, only uncontaminated/decontaminated personnel or materials may enter the Support Zone from the CRZ.

The Support Zone contains the necessary support facilities (including personal hygiene facilities) for site operations. It also serves as the communications center and source of emergency assistance for operations in the Exclusion Zone and CRZ. A log of all persons entering the site will be maintained by the HSO, the field operations leader, or the site designee.

APPENDIX H WORK PRACTICES

APPENDIX H WORK PRACTICES

H.1 GENERAL

Workers will be expected to adhere to the established safe work practices for their respective specialties (e.g., drilling, laboratory analysis, and construction). The need to exercise caution in the performance of specific work tasks is made more acute due to (1) weather conditions; (2) restricted mobility and reduced peripheral vision caused by the protective gear itself; (3) the need to maintain integrity of the protective gear; and (4) the increased difficulty in communicating caused by respirators. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved. Among the most important of these principles for working at a hazardous waste site are the following:

- In any unknown situation, always assume the worst conditions and plan responses accordingly.

- Use the buddy system. Under no conditions will any person be permitted to enter the Exclusion Zone alone. Establish and maintain communications. In addition to radio communications, it is advisable to develop a set of hand signals, because conditions may greatly impair verbal communications.

- Because no personal protective equipment is 100 percent effective, all personnel must minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures accordingly. Do not place equipment or drums on the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the Exclusion Zone or CRZ. Avoid standing in or walking through puddles or stained soil.

- Disposable items will be used, when possible, to minimize risks during decontamination and possible cross-contamination during sample-handling.

- Smoking, eating, or drinking in the work area and before decontamination will not be allowed. Oral ingestion of contaminants is a likely means of introducing toxic substances into the body.

- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.

- Maintain monitoring systems. Conditions can change quickly if subsurface areas of contamination are penetrated.

- Conflicting situations that may arise concerning safety requirements and working conditions must be addressed and resolved rapidly by the HSO to avoid any motivation or pressure to circumvent established safety policy.

- To the extent feasible, handling of contaminated materials should be done in a remote area, particularly when drummed or other containerized hazardous waste materials are found on-site. Every effort should be made to identify the contents of containers found on-site before they are subject to material-handling applications.

- Personnel must be observant of not only their own immediate surroundings but also that of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while using personnel protective gear because vision, hearing, and communication can be restricted.

- Contact lenses are not allowed to be worn on-site; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.

- All facial hair that interferes with the face piece fit must be removed before donning a respirator at all sites requiring Level C or Level B protection.

- Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.

- The site leader, HSO, and sampling personnel will maintain project records in a bound notebook (e.g., daily activities, meetings, incidents, and data). Notebooks will remain on-site for the project duration so that replacement personnel may add information, thereby maintaining continuity. The notebooks and daily records will become part of the permanent project file.

H.2 SITE ENTRY PROCEDURES

In most cases, ABB-ES teams are not the first on-site investigators. Considerable knowledge of site history and current status allows preparation of a HASP with reasonable assurance that personnel are adequately protected. In the event that sufficient site information is not available to perform a summary risk assessment and assign the appropriate level of personal protective equipment, the following procedures should be followed. It must be understood that verification of the level of contamination (even with background information) will always require some of the following steps.

1. Recognize that ABB-ES's presence on-site implies a perceived contamination potential by the client.

2. Assume that the site is contaminated and conduct a site safety reconnaissance, consisting of the following activities:

- Establish a CRZ (decontamination area).

- Survey the site at the highest level of protection practicable, beginning with a perimeter survey and gradually covering all areas of proposed activity with the following (as appropriate):

  - HNU PI meter or equivalent
  - OVA
  - radiation survey meter
  - personal air sampling pumps
  - chemically reactive indicator tubes
  - oxygen-deficiency meter
  - explosive mixture meter

- Establish a "hot zone."
- Review data, assess risk, and select the appropriate level of protection.

3. Prepare a summary site HASP and document all data acquired.

APPENDIX I PERMIT-REQUIRED CONFINED SPACES

APPENDIX I PERMIT-REQUIRED CONFINED SPACES

I.1 INTRODUCTION

A worker entering a confined space can be exposed to multiple hazards if conditions are not understood or safety regulations are not enforced. Most accidents result from failure of workers to recognize a confined space as a potential hazard. Ignorance and negligence have led to a number of deaths each year by asphyxiation, fire and explosion, and/or fatal exposure to toxic materials (Table I-1). Because of this, OSHA developed the Permit-Required Confined Spaces Standard (29 CFR 1910.146).

ABB-ES associates may encounter a variety of confined spaces when working at hazardous waste sites. As the confined spaces found at hazardous waste sites are typically unknown and usually require only a single entry, all spaces will be considered permit-required unless otherwise allowed by the Health and Safety Manager (HSM).

Before entry into a confined space is permitted, the Health and Safety Officer (HSO) will ensure that the Health and Safety Plan (HASP) addresses the entry and that the entry permit has been issued. Items that will be addressed in the HASP and/or the Permit will include the following:

- Measures to use to prevent unauthorized entry.
- Identification and evaluation of the hazards.
- Means, procedures, and practices necessary for safe entry.
- Availability and proper use of required equipment.
- Procedures to determine if acceptable entry conditions exist and that they are maintained before and during entry.
- Testing or monitoring of space to ensure acceptable conditions are maintained.
- Identification of associates with active roles such as authorized entrants, attendants, entry supervisor, and rescue including assignment of duties.
- Training
- Rescue procedures
- Permit preparation, issuance, use, and cancellation.
- Coordination of entry with subcontractor.
- Review of entry operations

TABLE I-1
ACCIDENTS AND ILLNESS TYPE
CONFINED SPACE (CS)

REF. NO.	ACCIDENT AND ILLNESS TYPE	EVENTS	INJURIES	FATALITIES
1	Atmospheric Condition in CS	80	72	78
2	Explosion or Fire in CS	15	49	15
3	Explosion or Fire at Point-of-Entry to CS	23	20	32
4	Electrocution or Electrical Shock	11	2	9
5	Caught In/Crushing of CS	10	3	10
6	Trapped in Unstable Materials in CS	16	0	16
7	Struck by Falling Objects in CS	15	1	14
8	Falls (while in CS; not into CS)	27	26	1
9	Ingress/Egress of CS	33	30	3
10	Insufficient Maneuverability in CS	15	15	0
11	Eye Injury in CS	10	10	0
12	Contact with Temperature Extreme in CS	7	4	3
13	Noise in CS	1	1	0
14	Vibration in CS	1	1	0
15	Stress from Excess Exertion in CS	12	0	12
Totals		276	234	193

Safety Sciences, San Diego, California - 1977 [1]

I.2 MEASURES TO PREVENT UNAUTHORIZED ENTRY

Depending on site conditions, the actual confined space plus a suitable area around the entrance will be considered the Exclusion Zone. Only those who meet the training requirements of The Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) and the Permit-Required Confined Spaces (29 CFR 1910.146) will be allowed in this area.

The perimeter of the Exclusion Zone will be identified by flagging or some other method The actual confined space will remain sealed, locked, or otherwise protected until authorization for entry is given. If the entryway into the confined space cannot be protected from unauthorized entry, a sign stating **DANGER - PERMIT REQUIRED CONFINED SPACE, DO NOT ENTER** will be placed on or near the entry. It is the responsibility of the HSO to ensure that the above procedures are followed.

I.3 IDENTIFICATION AND EVALUATION OF HAZARDS

When evaluating a confined space and determining its exposure potential, both physical and chemical hazards must be considered.

I.3.1 Physical Classification

Confined Spaces are defined as areas large enough and so configured that an employee can enter the space and perform assigned work, has limited or restricted access, and is not designed for continuous occupancy. Confined spaces can be categorized generally as those with open tops and a depth that restricts the natural movement of air, and those with very limited openings for entry. In either case, the space may contain electrical or mechanical equipment with moving parts. Any combination of these parameters changes the nature of the hazards encountered. Degreasers, pits, and certain types of storage tanks may be classified as open-top confined spaces that usually contain no moving parts. However, gases that are heavier than air (i.e., butane, propane, and other hydrocarbons) remain in depressions and will flow to low points where they are difficult to remove. Open-top water tanks or test pits that appear harmless may develop toxic atmospheres (e.g., hydrogen sulfide or chlorinated hydrocarbons) from the vaporization of contaminated water or soil. Therefore, these heavier-than-air gases are a primary concern when entering such a confined space. Other hazards may develop due to the work performed in the confined space or corrosive residues that accelerate the decomposition of scaffolding supports and electrical components.

Confined spaces such as sewers, casings, tanks, silos, vaults, and compartments of ships usually have limited access. The problems associated with entry into these areas are similar to those that occur in open-top confined spaces. However, limited access increases the risk of injury. Heavier-than-air gases (e.g., carbon dioxide and propane) may lie in a tank or vault for hours or even days after the container is opened. Because some gases are odorless, the hazard may be overlooked, with fatal results. Lighter-than-air gases may also be trapped within an enclosed-type confined space, especially those with access from the bottom or sides.

The most hazardous confined space is one that combines limited access and mechanical or electrical devices. All the hazards of open-top and limited-access confined spaces may be present, together with the additional hazard of moving parts. Digesters and boilers usually contain power-driven equipment which, unless properly isolated, may inadvertently be activated after entry. Such equipment may also contain physical hazards that further complicate the work environment and the entry and exit process.

I.3.1.1 **Physical Hazards**. Physical hazards that may be encountered in a confined space include non-chemical, physiologic stresses such as thermal effects (heat and cold), noise, vibration, radiation, and fatigue.

I.3.1.1.1 **Thermal Effects**. Four factors influence the interchange of heat between humans and the environment:

- air temperature
- air velocity
- moisture contained in the air
- radiant heat

Because of the nature and design of most confined spaces, moisture content and radiant heat are difficult to control. As the body temperature rises progressively, a worker continues to function until the body temperature reaches 38.3° to 39.4°C (101° to 103°F). When this body temperature is exceeded, the worker is less efficient, and is prone to heat exhaustion, heat cramps, or heat stroke. In a cold environment, certain physiologic mechanisms come into play that tend to limit heat loss and increase heat production. The most severe strain in cold conditions is the chilling of extremities so that activity is restricted. Special precautions must be taken in cold environments to prevent frostbite, trench foot, and general hypothermia.

I.3.1.1.2 **Noise**. Noise problems are usually intensified in confined spaces because the interior tends to cause sound to reverberate, thus exposing the worker to audio levels higher than in an open environment. Intensified noise increases the risk of hearing damage to workers, which could result in temporary or permanent hearing loss, and/or could cause disorientation and affect the workers' ability to function even to the extent that they are unable to escape from the space. Noise in a confined space that may not be intense enough to cause hearing damage may still disrupt verbal communication with the emergency standby person outside the confined space. If the workers inside cannot hear commands or danger signals due to excessive noise, the probability of severe accidents can increase.

I.3.1.1.3 **Other Physical Hazards**. Some physical hazards cannot be eliminated because of the nature of the confined space or the work to be performed, including items such as scaffolding, surface residues, and structural hazards. The use of scaffolding in confined spaces has contributed to many accidents caused by workers or materials falling, improper use of guardrails, and lack of maintenance to ensure worker safety. The choice of material used for scaffolding depends on the type of work to be performed, the calculated weight to be supported, the surface on which the scaffolding is placed, and the substance previously stored in the confined space.

Surface residues in confined spaces can increase the already hazardous conditions of electrical shock, reaction of incompatible materials, liberation of toxic

substances, and bodily injury due to slips, trips, and falls. Without protective clothing, additional health hazards may arise due to surface residues.

Structural hazards within a confined space (e.g., baffles in horizontal tanks, trays in vertical towers, bends in tunnels, overhead structural members, or scaffolding installed for maintenance) constitute physical hazards that are exacerbated by the physical surroundings. In dealing with structural hazards, workers must review and enforce safety precautions to ensure safety.

Rescue procedures may require withdrawal of an injured or unconscious person. Careful planning must be given to the relationship between the internal structure, the exit opening, and the worker. Provisions must be made so the victim is positioned in front of the opening in such a configuration that he/she can be removed from the space. If the worker is above the opening, the system must include a rescue arrangement operated from outside the confined space, if possible, by which the worker can be lowered and removed without injury.

I.3.2 Chemical Classifications

Confined spaces are also classified according to existing or potential chemical hazards. The classification is based on characteristics of the confined space, oxygen level, flammability, and toxicity. Table I-2 defines the parameters of each classification. If any of the hazards present a situation that is Immediately Dangerous to Life and Health (IDLH), the confined space is designated as Class A and requires Level A or B personal protective equipment. The classification is determined by the most hazardous condition of entering, working in, and exiting a confined space. Class B confined spaces have the potential for causing injury and illness, but are not IDLH (Level B or C personal protective equipment). A Class C confined space is one in which the chemical hazard potential is minimal and does not require any special modification in work procedures (Level D personal protective equipment).

I.3.2.1 Hazardous Atmospheres

Hazardous atmospheres encountered in confined spaces can be divided into four categories: (1) oxygen-deficient, (2) flammable, (3) toxic, and (4) irritant and/or corrosive.

I.3.2.1.1 **Oxygen-Deficient Atmosphere**. The normal atmosphere is composed of approximately 20.9 percent oxygen, 78.1 percent nitrogen, and 1 percent argon, with small amounts of various other gases. Reduction of oxygen in a confined space may be the result of either consumption or displacement.

The consumption of oxygen occurs during combustion of flammable substances, as in welding, heating, cutting, and brazing. A more subtle consumption of oxygen occurs biologically (e.g., during the bacterial action of the fermentation process). Oxygen may also be consumed during chemical reactions (e.g., formation of rust [iron oxide] on the exposed surface of the confined space).

A second cause of oxygen deficiency is displacement by another gas. Helium, argon, and nitrogen are examples of gases that are intentionally used to displace air and which therefore reduce the oxygen level. Carbon dioxide may be

Table I-2
Confined Space Classification Table

PARAMETERS	CLASS A (LEVEL A OR B PPE)	CLASS B (LEVEL B OR C PPE)	CLASS C (LEVEL D PPE)
Characteristics	Immediately dangerous to life: rescue procedures require the entry of more than one individual fully equipped with life-support equipment; maintenance of communication requires an additional standby person stationed within the confined space.	Dangerous, but not immediately life-threatening: rescue procedures require the entry of no more than one individual fully equipped with life-support equipment; indirect visual or auditory communication with workers.	Potential hazard requires no modification of work procedures: standard rescue procedures, direct communication with workers from outside the confined space.
Oxygen	19.4 percent or less *(122-mm Hg) or greater than 23.5 percent *(190 mm Hg)	19.5 to 20.9 percent *(122- to 147-mm Hg) or 20.9 to 23.5 percent (163- to 190-mm Hg)	19.5 to 20.9 percent *(148- to 163-mm Hg)
Flammability Characteristics	20 percent or greater LEL	10 to 19 percent LEL	10-percent LEL or less
Toxicity	**IDLH	Between the TLV/PEL and the **IDLH. If air-purifying respirators are used, maximum level based on breakthrough time (1,000 ppm maximum).	Less than the TLV/PEL.
Respiratory Protection	SCBA or supplied air respirator with escape bottle.	SCBA, supplied air respirator with escape bottle or air-purifying respirator.	None.

* Based on total atmospheric pressure of 760-mm Hg (sea level).

** Immediately Dangerous to Life and Health, as referenced in NIOSH Registry of Toxic and Chemical Substances, Manufacturing Chemists data sheets, industrial hygiene guides, or other recognized authorities.

Notes: Hg = mercury; LEL = Lower Explosive Limit; PEL = Permissible Exposure Limit;
SCBA = Self-Contained Breathing Apparatus; TLV = Threshold Limit Value
PPE = Personal Protective Equipment

intentionally introduced to displace air, but can also naturally displace air (e.g., in sewers, storage bins, wells, tunnels, wine vats, and grain elevators).

I.3.2.1.2 **Flammable Atmosphere**. A flammable atmosphere generally arises from vaporization of flammable liquids, by-products of work, chemical reactions, enriched-oxygen atmospheres, concentrations of combustible dusts, and desorption of chemicals from inner surfaces of the confined space. An atmosphere becomes flammable when, in the presence of oxygen, the concentration is neither too rich nor too lean to burn. Combustible gases or vapors will accumulate when there is inadequate ventilation in an area (e.g., a confined space). Flammable gases (e.g., acetylene, butane, propane, hydrogen, methane, natural or manufactured gases, or vapors from liquid hydrocarbons) can be trapped in a confined space. Heavier-than-air gases will seek lower levels (as in pits, sewers, and various types of storage tanks and vessels). In a closed-top tank, lighter-than-air gases may rise and develop a flammable concentration if trapped at the top of the tank.

I.3.2.1.3 **Toxic Atmosphere**. The substances regarded as toxic in a confined space can cover the entire spectrum of gases, vapors, and finely divided airborne dust in industry. The forces of toxic atmospheres encountered may arise from the manufacturing process (e.g., in producing polyvinyl chloride, hydrogen chloride is used, as well as a vinyl chloride monomer, which is carcinogenic); the product stored (e.g., removing decomposed organic material from a tank can liberate toxic substances such as hydrogen sulfide); and the operation performed in the confined space (e.g., welding or brazing with metals capable of producing toxic fumes).

I.3.2.1.4 **Irritant (Corrosive) Atmosphere**. Irritant or corrosive atmospheres can be divided into primary and secondary groups. Primary irritants show responses at the point of contact and generally exert no systemic toxic effects. Examples of primary irritants are chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide. A secondary irritant is one that may produce systemic toxic effects in addition to surface irritation; for example, benzene, carbon tetrachloride, ethyl chloride, 1,1,1-trichloroethane, trichloroethylene, and 3-chloropropylene.

Prolonged exposure to irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This has been interpreted to mean that the worker has adapted to the harmful agent involved. In reality, it means there has been a general weakening of the body's defense reflexes due to damage of the nerve endings in the mucous membranes of the conjunctive and upper respiratory tract. The danger in this situation is that the worker is usually not aware of any decrease in his/her reaction to the toxic substance.

I.3.3 General Safety Hazards

I.3.3.1 **Communication Problems**. Communication between the worker inside a confined space and the standby person outside is of utmost importance. If the worker suddenly feels distressed and is not able to summon help, this condition could result in a fatality. Frequently, the body positions assumed in a confined space make it difficult for the standby person to detect an unconscious worker. When visual monitoring of the worker is not possible because of the design of the

confined space or location of the entry hatch, a voice- or alarm-activated, explosion-proof-type communication system is necessary.

Suitable and approved illumination is required to provide sufficient visibility for work. Illumination must be intrinsically safe and explosion-proof.

I.3.3.2 **Entry and Exit**. Entry and exit time can be of major significance if the physical limitations of the entryway hinder the rescue of an injured person. The degree of significance is directly related to the potential hazard of the confined space. The extent of precautions taken and the standby equipment needed to maintain a safe work area are determined by the means of access and rescue. The following should be considered: type of confined space to be entered; access to the entrance; number and size of openings; barriers within the space; maximum occupancy; and time required for exiting in the event of fire or vapor incursion, or to rescue injured workers.

I.4 GENERAL WORK PRACTICES

Before entry into a confined space is allowed, the HSO will ensure that procedures necessary to ensure safe permit entry are, identified, developed and implemented. These procedures may include purging and ventilation, and isolation (lock-out/tag-out),

I.4.1 Purging and Ventilation

For entering and working in a confined space, environmental control is accomplished by purging and ventilation. Purging is the initial step in adjusting the atmosphere in a confined space to acceptable standards (i.e., Permissible Exposure Limits [PELs], Threshold Limit Values [TLVs], and LELs). This is accomplished either by displacing the atmosphere in the confined space with fluid or vapor (i.e., inert gas, water, steam, and/or cleaning solution) or by forced-air ventilation.

The method used to purge or ventilate the confined space will be determined by the potential hazards that arise due to the product stored or produced, the suspected contaminants, the work to be performed, and the design of the confined space. When ventilating and/or purging operations are to be performed, the blower controls must be at a safe distance from the confined space. When a ventilation system is operational, air flow measurements (as well as atmosphere testing) must be made before each entry to ensure that a safe environmental level is maintained. Initial testing of the atmosphere should be performed from outside the confined space before ventilation begins to determine precautions necessary for purging and ventilating. Testing of more remote regions within the confined space may be performed once the immediate area within the confined space has been made safe. Exhaust systems should be designed to protect workers in the surrounding area from exposure to contaminated air. If flammable concentrations are greater or equal to 10 percent of the LEL, all electrical equipment must be intrinsically safe and explosion-proof. Continuous ventilation is required by OSHA where ever feasible. The atmosphere must be tested until acceptable levels of oxygen and contaminants are continuously maintained for three tests at 5-minute intervals. Care must be taken to prevent recirculation of contaminated air and interaction of airborne contaminants.

Continuous general ventilation should be maintained where toxic atmospheres may develop due to the nature of the confined space or the activities being performed, as in the case of desorption from walls or evaporation of residual chemicals. General ventilation is an effective procedure for distributing contaminants from a local generation point throughout the work space to obtain maximum dilution. However, special precautions must be taken if the ventilating system partially blocks the exit opening, including methods for providing respirable air to each worker for the time necessary to exit and for maintaining communications.

I.4.2 Isolation/Lock-out/Tagging

Isolation procedures must be specific for each type of confined space. Safety equipment required during this procedure will be designated by the HSO and will depend on potential hazards involved. A Class A or B confined space must be completely isolated from all other systems by physical disconnection, double-block and bleed, or blanking off all lines. In continuous systems, where complete isolation is not possible (e.g., sewers or utility tunnels), specific written safety procedures must be used. Shutoff valves, serving the confined space, must be locked in the closed position and tagged for identification. In addition to blanking, pumps and compressors serving the lines entering the confined space must be locked out to prevent accidental activation. If a drain line is located within the confined space, provision must be made, when necessary, to tag it and leave it open; this will be recorded in the HASP.

Electrical isolation of the confined space to prevent accidental activation of moving parts that would be hazardous to workers is achieved by locking circuit breakers and/or disconnects in the open (off) position with a key-type padlock. The only key to the padlock is to remain with the person working inside the confined space. If more than one person is inside the confined space, each person must place his own lock on the circuit breaker. In addition to the lockout system, there must be an accompanying tag that identifies the operation and prohibits use.

Mechanical isolation of moving parts can be achieved by disconnecting linkages or removing drive belts or chains. Equipment with moving mechanical parts must also be blocked to prevent accidental rotation.

I.5 EQUIPMENT

The HSO will ensure that prior to entering a confined space, all required equipment is present on site, in good working order, and that all associates are knowledgeable in their use. The HASP and entry Permit will include a list of necessary protective equipment to be used in the confined space, as determined by the HSO. Items to consider include head, eye, face, and foot protection against traumatic injury, respiratory, hand, and body protection for chemical hazards injuries, as well as ventilating, monitoring and rescue equipment.

Equipment that may be required on sites includes the following:

- Testing and monitoring equipment
- Ventilating equipment
- Communication equipment
- Personal protective equipment

- Lighting equipment
- Barriers and shields
- Ladders or other means of ingress or egress
- Rescue and emergency equipment
- Other

Standard items required at all sites are identified on the entry permit.

I.5.1 Eye and Face Protection

If eye-irritating chemicals, vapors, or dusts are present, safety goggles are required, unless a full-face respirator is used. If both the face and eyes are exposed to a hazard (e.g., during scraping scale), a full-face shield and goggles must be used. For those who wear corrective glasses, prescription safety glasses or goggles can be acquired through ABB-ES. As a general safety precaution, eye protection meeting the requirements and specifications of American National Standards Institute (ANSI) Standard Z89.1-1981 Class B should be worn at all times while in the confined space.

I.5.2 Head Protection

Hard hats must be worn if working directly under the manhole or entryway, if there is any danger of items falling on the worker's head, or as an adjunct to face protection. All hard hats must meet the requirements and specifications of ANSI Standard 289.1-1968.

I.5.3 Foot Protection

Steel-toe, steel-shank, chemical-resistant boots (or boot covers) must be worn when entering a confined space if there is a danger of falling objects, stepping on a sharp object or nail, and/or chemical contaminants. All safety-toe footwear must meet the requirements and specifications of ANSI Standard 241.1-1967.

I.5.4 Body Protection

The level of dermal protection to be worn by all personnel entering the confined space will be determined by the HSO, based on all data available. In choosing the level of protection, the HSO must consider the chemical hazard present, as well as the potential for heat and cold stress.

I.5.5 Hearing Protection

A hearing conservation program must be implemented if sound pressure levels equal or exceed 85 dBA (decibels on the A scale), based on an 8-hour, time-weighted average (TWA). Hearing protection is mandatory for noise levels above 90 dBA, and optional between 85 and 90 dBA. If noisy conditions are expected within the confined space, the HSO should notify the Health and Safety Manager (HSM) or the Health and Safety Supervisor (HSS) and make arrangements to have ear plugs at the site.

I.5.6 Respiratory Protection

The HSO will determine the level of respiratory protection, based on conditions and test results of the confined space and the work activity to be performed. (See Appendix G2 for selection guidelines.)

I.5.7 Hand Protection

Gloves of impervious rubber or similar material are to be worn to protect against toxic or irritating materials. If rough surfaces or sharp edges are expected, canvas or metal mesh can be worn over the rubber gloves. Where isolation of the electrical system is impossible, and current flow of more than 5 milliamperes through the body could potentially occur due to contact with energized electrical equipment, insulating gloves should be worn. These gloves must meet the requirements and specifications of ANSI Standard J6.6-1967.

I.5.8 Safety Belt/Harness

Non-entry rescue (e.g., retrieval systems) must be used whenever an authorized Entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Each Entrant shall use a chest or full body harness with a retrieval line attached at the center of the Entrants back near shoulder level or above the Entrants head. Wristlets may be used in lieu of the chest or full body harness if the ABB-ES can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative (e.g., opening is less than 18 inches in diameter). The other end of the retrieval line must be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device must be available to retrieve personnel from vertical type spaces of greater than 5 feet deep.

I.5.9 Other

When employees enter a confined space, a barricade must be erected if inadvertent entry poses a problem. The barricade must have a mechanism to prevent closure of the escapeway, signs warning of the danger present, a physical barrier (i.e., fence) to keep the area clear, and an adequate platform (a minimum size of 3 by 3 feet) for entry or exit. Added features such as a tripod with either block and tackle or a mechanical pulley mechanism should be used in situations where quick removal of a worker may be required. Communications equipment (i.e., intercoms or radio systems) should be considered when the entry plan is formulated.

I.5.10 Equipment and Tools

Equipment and tools to be used in a confined space must be carefully inspected, and must meet the following requirements:

- Hand tools must be kept clean and in good repair.
- Portable electric tools, equipment, and lighting must be equipped with a ground fault circuit interrupter. All grounds must be checked before electrical equipment is used in a confined space.

- All electrical cords, tools, and equipment must be heavy duty, with heavy duty insulation, and inspected for visually detectable defects before use in a confined space. For use in a flammable atmosphere, their design must be explosion-proof and intrinsically safe.

- Air-driven power tools must be used when flammable liquids are present. The use of air-driven power tools will only reduce the risk of explosion, not eliminate it. Explosions can result from tools overheating (e.g., drilling), sparks produced by striking (e.g., percussion), grinding, or discharge of accumulated electrostatic charges developed from the flow of compressed air.

- Lighting used in Class A and Class B confined spaces must be explosion-proof and intrinsically safe and, where necessary, equipped with guards. Only equipment listed by the Underwriters Laboratories for use in Division 1, atmospheres of the appropriate class and group, or approved by U.S. Bureau of Mines, Mining Enforcement and Safety Administration, Mine Safety and Health Administration, or the U.S. Coast Guard should be used. Lighting should not be hung by electrical cords, unless specifically designed for that purpose. The illumination of the work area must be sufficient to provide for safe working conditions. Under no circumstances will matches or open flames be used in a confined space for illumination.

- Cylinders of compressed gas must never be taken into a confined space, and should be turned off at the cylinder valve when not in use. Exempt from this rule are cylinders that are part of self-contained breathing apparatus (SCBA) or resuscitation equipment.

- Ladders should be adequately secured, or of a permanent type that provides the same degree of safety.

- Scaffolding and staging must be properly designed to carry maximum expected load (safety factor of four), and be equipped with traction-type planking.

- Only hose lines and components specially designed for the compressed gas and working pressure should be used, and such systems must have a pressure relief valve outside the confined space.

I.6 TESTING AND MONITORING

Prior to entry into a confined space, workers must know its potential hazards. Deaths *have* occurred because a presumably safe space was not tested before initial entry. The OSHA Permit-Required Confined Space standard requires the following sequence of testing, in the order given, prior to entry into confined spaces:

1. Oxygen Content

2. Flammability

3. Toxic Chemicals

In addition to testing for chemical hazards, harmful physical agents (e.g., explosive dusts, noise, etc.) should also be conducted.

Specific instruments are required to test the atmosphere for these conditions. For example, combustible gas indicators are designed to measure the concentration of flammable gases, and will not measure or indicate the presence of carbon monoxide (CO) at toxic levels; conversely, a CO detector is designed to measure CO only. Combustible gas indicators respond differently to different flammable hydrocarbons; therefore, entry into confined spaces with flammable gas concentrations above 20 percent of the Lower Explosive Limit (LEL) should be avoided. The flammability measurement may be erroneous if the oxygen level is less than or greater than normal atmospheric concentrations. Therefore, it is required that the oxygen level be determined prior to flammability testing to make any necessary corrections in the flammability measurement.
The oxygen-deficiency measuring instrument is designed to measure the volume of oxygen present, usually scaled with a range of zero to 25 percent. If the oxygen level in a confined space atmosphere is less than 19.5 or greater than 23.5 percent, special precautions must be taken. In accordance with Occupational Safety and Health Administration (OSHA) Standard 29 CFR Part 1910 and other references, a minimum oxygen level of 19.5 percent has been adopted for worker safety. (This assumes that the 1.4 percent displaced oxygen was replaced with a nonhazardous substance.) The upper oxygen limit has been set at 23.5 percent because an increase above this level will greatly increase the rate of combustion of flammable materials.

Continuous and/or frequent monitoring becomes necessary in cases where the work being performed within the confined space has the potential of generating toxic agents. Data collected for the National Institute for Occupational Safety and Health (NIOSH) show that in 28 of 80 accident events, the toxic gas or oxygen deficiency was not in the confined space at the time of entry, but was either generated by the work occurring in the space, or by gas being unexpectedly admitted into the confined space after the worker had entered. In these cases, only continuous and/or frequent monitoring would be a possible countermeasure.

I.7 ENTRY PERMIT

Before entry into a confined space is authorized, the HSO must document the completion of all required safety measures required by the OSHA Permit-Required Confined Space Standard. Documentation of these measures is done on the Confined Space Entry Permit (see Appendices G2 and G3). Entry into any confined space is by permit only unless first cleared by the HSM. The entry permit is an authorization and approval, in writing, that specifies the personnel permitted to enter the space and the location and type of work to be done. It certifies that all known hazards have been evaluated and necessary protective measures have been taken to ensure the safety of each worker. The entry permit will identify the permit space to be entered, the purpose of the entry, the date and authorized duration of the entry, the authorized entrants, the authorized attendants, the name and signature of the HSO, the hazards, measures used to isolate or eliminate the hazards, acceptable entry conditions, results of initial and periodic air monitoring, rescue and emergency procedures, communication procedures, equipment, as well as any other pertinent information or permits (e.g. for hot work) required.

At the site, the HSO acts as the Entry Supervisor and is responsible for the completion of the Confined Space Entry Permit and/or the Manhole/Sewer Entry Permit, ensuring that atmospheric testing has been conducted and all safety precautions have been addressed. The Permit will be posted at or near the entry portal so that all associates can confirm that pre-entry preparations have been completed. The entry permit applies only to the task or job identified and entry into the confined space cannot exceed the time required to complete the assigned task or job.

The HSO will terminate entry and cancel the entry permit when entry operations covered by the permit have been completed or a condition not allowed by the permit arises in or near the confined space. If problems are encountered during the entry operation, the HSO shall note it on the permit.
THE COMPLETED PERMIT MUST BE SENT TO THE HSM AS ABB-ES MUST RETAIN AND REVIEW EACH CANCELED PERMIT ANNUALLY.

I.8 TRAINING/HEALTH MONITORING

ABB-ES personnel required to work in confined spaces, or in support of those working (if their duties include emergency rescue) in confined spaces, must be in the Health Monitoring Program and have received the 40-hours of initial hazardous waste site training, initial Confined Space Entry training, and site specific training. In addition, associates who act as Rescue personnel must maintain current certification in first aid and CPR and be trained in and have practiced rescue procedures immediately prior to entry.

As ABB-ES workers encounter a variety of confined spaces at a various locations, site specific training plays an important role in informing associates of the hazards associated with the entry. Site specific training shall be conducted prior to each entry, whenever there is a change in operations which an associate has not previously been trained, when there is a reason to believe that there are deviations from the permit space entry procedures, or inadequacies in the associate's knowledge or use of the procedures.

Training will include, but limited to, a review of the contents of the HASP and permit, verification of associate knowledge and/or training on the use all equipment to be used, emergency procedures, site specific hazards and the duties of their assigned role.

I.9 ROLES AND RESPONSIBILITIES

I.9.1 Duties of Authorized Entrants

The authorized entrants are the workers who actually enter the confined space and are therefore at the greatest risk. Because of this added degree of risk, these workers must be knowledgeable of the hazards they may be faced with during entry, including the mode, signs or symptoms, and consequences of the exposure and have the knowledge and skills necessary to recognize a prohibited condition or dangerous situation. The Entrants must be made aware of and know the use of all the equipment they are required to use while in the confined space.

Communication is very important while workers are in a confined space. Entrants and Attendant must be in constant communication with each other to:

- Enable the Attendant to monitor the Entrants status
- To allow the Entrant to alert the Attendant whenever the Entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or when the Entrant detects a prohibited condition.
- To have the Entrant exit from the permit space as soon as possible whenever an order to evacuate is given by the Attendant or the HSO, when the Entrant recognizes any warning sign or symptom of exposure to a dangerous situation, when the Entrant detects a prohibited condition, or when an evacuation alarm is detected.

I.9.2 Duties of Attendants

The Attendant is responsible for ensuring the safety of the Entrants into a confined space and therefore must not perform any other duties that might interfere with the Attendants primary duty of monitoring and protecting the Entrants. The Attendant must be aware of the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure. The Attendants must be aware of the possible behavioral effects of the hazard exposure and continuously maintain an accurate count and identification of the authorized entrants in the space. The Attendant remains outside the permit space at all times during entry operations until he/she is relieved by another attendant. The Attendant must be in constant communication with the Entrants to monitor their status and to alert entrants of the need to evacuate the space. The Attendant monitors activities inside and outside the space to determine if it is safe to remain in the space and orders the Entrants to evacuate immediately under any of the following conditions:

- The Attendant detects a prohibited condition
- The Attendant detects the behavioral effects of a hazard exposure
- The Attendant detects a situation outside the space that could endanger the Entrants.
- The Attendant cannot effectively and safety perform all his/her duties.

The Attendant is responsible for summoning rescue and other emergency services as soon as the Attendant determines that the Entrants may need assistance and warns unauthorized persons that they must stay away or exit the space immediately should they approach or enter the confined space while entry is underway. Should unauthorized persons approach or enter the confined space, the Attendant must inform the HSO immediately.

The attendant is allowed to perform non-entry rescue only unless they meet the requirements to be on the Rescue Team and they are first relieved by another attendant.

I.9.3 Duties of Entry Supervisors (HSO)

The Entry Supervisor (HSO) has overall responsibility for the entry into the confined space. They are required to be knowledgeable of the hazards associated with the entry, including information on the mode, signs or symptoms, and consequences of exposure. The HSO is responsible for verifying, by checking, that the appropriate entries have been made on the permit, that all tests have been conducted, and that all procedures and equipment specified by the permit or in the HASP are in place before endorsing the permit and allowing entry. In addition, the HSO is responsible for terminating the entry and canceling the permit whenever entry operations covered by the permit have been completed or if conditions not allowed under the entry permit arises in or near the space. The HSO is required to ensure that all affected workers are properly trained and receive site specific training. The HSO is required to verify that the rescue services are available and the means for summoning them are operable. If ABB-ES rescue team is used, the HSO is responsible for ensuring that all Rescue team members have practiced rescues from the actual or a representative space prior to (within the last 12 months) authorizing entry into the confined space.

He/she is responsible for removing unauthorized individuals who enter or attempt to enter the confined space during entry operations. If the responsibility for a confined space is transferred or at predetermined intervals based on the hazards and operations performed with in the space, he/she determines that entry operations remain consistent with the terms of the permit and that acceptable entry conditions are maintained.

I.9.4 Duties of Rescue and Emergency Services

Non-entry rescue (e.g., retrieval systems) must be used whenever an authorized Entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

The HSO must identify and verify that rescue and emergency services are available prior to allowing entry into a confined space. Rescue and emergency services personnel can be ABB-ES associates only if the following conditions are met.

Each member of the rescue team has received the following training:

- Proper use of personal protective equipment
- Proper use of rescue equipment necessary for making rescues from permit spaces
- Assigned Rescue duties
- Duties of the authorized Entrants.
- First aid
- CPR

The Rescue team must practice making confined space rescues at least once every 12 months from the actual or a representative confined space. A representative space is one in which the opening size, configuration, and accessibility is

similar to the actual confined space. As it will be difficult to anticipate the types of spaces that ABB-ES associates encounter, the practice rescue will more than likely have to take place immediately prior to entry using the actual confined space. When simulating rescue operations, workers must practice removing dummies, manikins, or actual persons from the confined space (or a representative space).

If an outside service is to be used for rescue, the HSO must inform the rescue service of the hazards involved with entry into the space, and provide access to all the confined space(s) so that they can develop appropriate rescue plans and practice rescue operations.

I.10 RESCUE PROCEDURES

Rescue procedures to be used are site specific and will be developed as part of the HASP.

I.11 HOST EMPLOYER/CONTRACTOR/SUBCONTRACTOR

When confined space entry procedures are done in conjunction with another company (host employer/contractor/subcontractor), the entry will be coordinated to ensure that is done is a safe manner for all concerned. If the host employer or Contractor has existing confined space entry procedures, ABB-ES will attempt to obtain and review these procedures as well as all available information regarding the space and the hazards associated with it. If the host employer's/contractor's procedures meet ABB-ES minimum safety procedures, those precautions and procedures will be used. If ABB-ES feels that more stringent entry procedures are warranted, they will notify the host employer of the methods they will use when entering the confined space.

If ABB-ES is the General Contractor at the site, they will notify the subcontractor of the existence of permit-required confined spaces and that entry is allowed only through compliance with an Confined Space Entry Program. ABB-ES will notify the subcontractor of the hazards, precautions, and procedures ABB-ES has implemented for working in or near the space.

All entries will be coordinated with the host employer, contractor, or subcontractor personnel as required. ABB-ES will debrief the subcontractor or inform the host employer/contractor at the conclusion of the entry operations of any hazards confronted or created in the confined space.

I.12 REVIEW OF PERMIT-REQUIRED CONFINED SPACE PROGRAM

The HSM will review the Permit-Required Confined Spaces program on an annual basis or whenever there is reason to believe that measures taken under the program may not protect ABB-ES associates. The HSM will review the Program using the completed permits as well as all other available information as a guide. Based on the findings, the HSM will revise the Program, as appropriate to correct deficiencies to ensure that associates are protected from permit space hazards. No associate will be allowed to enter a confined space until all deficiencies are corrected.

I.13 GENERAL ENTRY PROCEDURES

This subsection describes general entry procedures for confined spaces. The actual procedures used on a site may vary, depending on site conditions and the hazards associated with the confined space.

I.13.1 Team Size

A minimum of two workers are required for each confined space activity, one Entrant and One Attendant/Entry Supervisor (HSO). This is for a relatively non-hazardous space where a non-entry retrieval system is being used. Arrangements for a rescue team must still be done, however, they do not have to present during the entry. Additional personnel will be needed for larger, hazardous, more complex entries, especially where there is a possibility that a rescue team may need to enter the space to rescue the Entrant. In these circumstances, a minimum of four workers are required, one Entrant, one Attendant, one HSO, and one Rescue.

These are the minimum numbers required, in most cases. Additional crew members may be needed if entering a Class A or Class B confined spaces, or specialty tasks must be completed. Additional crew could include additional Entrants, decontamination personnel, etc.

I.13.2 General Entry Procedures

The following steps must be taken when entering a confined space:

(1) Check and calibrate all pieces of equipment to ensure they are in good working order. DO NOT ENTER A CONFINED SPACE WITH DEFECTIVE EQUIPMENT!

(2) Conduct a background check to identify all potential hazards that may be encountered in the confined space. Determine if there is a potential for fire/explosion hazards, as well as a toxic or oxygen-deficient atmosphere.

(3) Define and demarcate the exclusion zone with flagging or some other method. Ensure that the entrance into the confined space remains locked, blocked, or otherwise protected until workers are ready to enter the space. If the entrance cannot be protected from unauthorized entry, place a sign one or near the entry stating **DANGER - PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER.**

(3) Before entry, test the atmosphere inside the confined space. An attempt should be made to test the atmosphere without opening the entryway (i.e., through a vent line or a small opening). If the entryway must be opened to test and only low levels are expected in the confined space, crack open the entryway, test the breathing zone first, and then test the confined space. If potentially high levels are expected in the breathing zone, respiratory protection should be worn while opening the entryway cover.

(4) If an oxygen deficient, explosive, or toxic atmosphere is detected, purge or ventilate the confined space before entry. Retest the

atmosphere three times at 5-minute intervals. A person can enter the confined space without respiratory protection only if all three test results are below the PEL/TLV, 10 percent of the LEL, and above 19.5 percent oxygen (all three conditions *must* be met). (NOTE: Any downward deflection of the readings on the oxygen meter from background [i.e., 20.9 percent] should be viewed as a potential for an IDLH atmosphere. Unless contaminants are known to be nontoxic, do not enter the confined space without respiratory protection if the oxygen level is below background.

(5) Blank, block, or otherwise isolate, lock-out, and tag all chemical, physical, and/or electrical hazards, wherever possible.

(6) If Entrants are using an air-purifying respirator or if an IDLH and/or explosive atmosphere exists, air monitoring must be on a continuous basis. If respiratory protection is not used and there is potential for atmospheric conditions to change due to work practices or conditions, air monitoring should be done continuously or periodically as site conditions warrant. In all these cases, a 5-minute escape pack must be used.

(7) Record all results of the tests for hazardous conditions, including the location, time, date, weather (if applicable), and readings on the photoionization detector (PID), combustible gas meter, oxygen-deficiency meter, Draeger tubes, and any other equipment used on the Confined Space Entry Permit.

(8) Wear appropriate clothing for site conditions, as determined by the HSO.

(9) Wear a safety belt or harness with lifeline when entering a confined space unless their use is not feasible or is a safety hazard. If the diameter of the entryway is less than 18 inches, the wrist-type harness must be use, and special provisions made if a supplied-air respirator is necessary.

(10) The HSO must check to ensure that the Confined Space Entry Permit is completed and all associates are adequately trained before authorizing entry.

(11) One person (Attendant) must remain at the entryway at all times and must maintain continuous contact with the person entering the confined space. Contact can be maintained by line of sight, listening for sounds, the safety line, and/or radio. The Attendant must not enter the confined space unless the non-entry retrieval is inoperable or infeasible, they are a trained rescuer, another trained person is available to act as an Attendant, and he/she is equipped with adequate respiratory and dermal protection. (In most cases, respiratory protection would be an airline respirator or SCBA.)

(12) Do not smoke when working in or near confined spaces, and do not take flash-lit photographs when explosive gases are known or suspected to be present.

(13) Do not rely on permanent ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect permanent ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable ladder of adequate height to reach 3 feet above opening, or a rope ladder, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off, if possible; otherwise, it should be held in place by the standby person.

(14) Do not work without adequate lighting. Use only explosion-proof lights or hand lamps.

(15) The entry person must not remain in the confined space if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Many gases that cause the most problems are odorless, tasteless, and invisible.

(16) THE HSO MUST CANCEL THE PERMIT, NOTE AND PROBLEMS ENCOUNTERED AND SEND COMPLETED FORM TO THE HSM IN PORTLAND MAINE.

I.13.3 Manhole/Sewer Entry

When preparing to enter a manhole/sewer, the following safety measures must be taken.

(1) Check all pieces of equipment to ensure they are in good working order. DO NOT ENTER THE MANHOLE WITH DEFECTIVE EQUIPMENT!

(2) Park the vehicle near the manhole (DO NOT leave the vehicle running). If the manhole is in the street, it is best to park so as to detour oncoming traffic around the manhole. The vehicle's emergency flashers and portable yellow warning beacon must be ON. The vehicle serves as protection from oncoming traffic, can be used to store emergency equipment (e.g., SCBA and first-aid kit), and can be used in extreme emergency to slowly pull an injured person from the confined space if a tripod with hoist attachment is unavailable or inoperable.

(3) When appropriate, erect portable barricades or cones around the manhole and in front of the vehicle to adequately divert traffic and to prevent pedestrians from falling in. Reflective vests should be worn so that workers are visible to approaching traffic.

(4) If there are openings large enough to admit sampling tubes, test for the presence of explosive and toxic gases before removing each manhole cover. Otherwise, raise one side of the cover using the cover hook or pick, prop it slightly open, and conduct the tests.

(5) If toxic or explosive gases are detected in the sewer that could be indicative of a spill, leak, or otherwise hazardous condition, report this immediately to the local fire department and/or department of public works.

(6) On the Manhole/Sewer Entry Permit, record the results of tests for hazardous conditions, including location, manhole number (if applicable), time, date, weather (if applicable), and readings on the PID, combustible gas meter, oxygen-deficiency meter, and Draeger tube. Once the Manhole/Sewer Entry Permit is completed, the HSO will verify all information before authorizing entry.

(7) Remove manhole covers with a cover hook or pick; do not improvise. Be careful of fingers and toes; the cover is usually heavy and difficult to handle. Unless the cover is extremely heavy, it is safer for only one worker to handle it.

(8) Test the atmosphere; if a toxic, flammable, or oxygen-deficient atmosphere exists, ventilate the sewer. Depending on the hazard, ventilation can be accomplished in several ways; for example: (1) remove and vent the adjoining upstream and downstream manhole covers, as soon as possible, and well in advance of entering the manhole (high hazard); and (2) vent the manhole in which entry will occur (very low hazard). If a blower is used, it is desirable to establish a flow of air in the sewer; that is, in one manhole and out another. Ensure that the air intake is well away from automobile exhaust, and combustible and/or toxic atmospheres. Appropriate traffic control measures must be taken by barricading or otherwise marking the open manholes.

(9) After ventilating, test for explosive and toxic gases and oxygen deficiency in the manhole at ground level and at the bottom; record the results. If entering the sewer itself, perform the same tests at the manholes at either end. If ventilation is necessary, monitor the atmosphere in the manhole while work progresses, or continue operation of the blower. Continuous monitoring (i.e., equipment ON during entire entry) is imperative because conditions within the sewer may change rapidly. Do not enter a manhole while there is an oxygen deficiency without a pressure-demand, air-supplied breathing apparatus. If the oxygen level is lower than 20.9 percent of background, caution must be taken because an IDLH atmosphere may exist.

(10) When entering manholes or tanks, wear hard hats, protective clothing, and appropriate respiratory protection and safety belt or harness with lifeline (when appropriate). If the manhole is less than 18 inches in diameter, a wrist-type harness must be used and special provisions made if air-supplied respirators are necessary. When working in manholes deeper than 12 feet, in the sewer itself, or where potential exists for gases to appear unexpectedly, a 5-minute emergency egress air supply is required (unless the time required to don the emergency respirator is greater than what would be needed to exit the manhole).

(11) At least one person (i.e., standby) must remain at the manhole at all times and must maintain continuous contact with the person entering the sewer. Contact can be maintained by line of sight, listening for prearranged sounds, and the safety line signals and/or radio. The standby person must not enter the manhole unless another trained

person is available to act as standby and has adequate respiratory and dermal protection available. (In most cases, respiratory protection will be an airline respirator or SCBA.) The stand-by/rescue person should be suited up (but not yet on air) before the work crew enters the confined space.

(12) Do not smoke when working in or near manholes. Do not take flash-lit photographs when explosive gases are known or suspected to be present.

(13) Do not rely on the manhole ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect manhole ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable or rope ladder of adequate height to reach 3 feet above the manhole opening, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off if possible; otherwise, it should be held in place by the standby person.

(14) Do not work without adequate lighting. Use only explosion-proof lights or hand lamps in the manhole or sewer.

(15) The entry person must not remain in the manhole or sewer if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Remember that CO, carbon dioxide, methane, and hydrogen sulfide, which cause the most trouble, are odorless (e.g., hydrogen sulfide has a distinct odor only during initial exposure), tasteless, and invisible gases.

(16) Once the permitted work is completed, the HSO will cancel the permit, note any problems, and send it to the HSM in Portland Maine.

I.13.4 Alternate Procedures

ABB-ES may use the alternate procedures described below for entering a confined space when they can demonstrate and document, through monitoring and inspection data, that the only hazards associated with the space are atmospheric and that continuous forced air ventilation alone is sufficient to maintain the space safe for entry. If workers must first enter the space to obtain the data required to demonstrate that alternate procedures can be used, the entry shall be done through the use of a permit in compliance with the all sections of the Permit-Required Confined Spaces standard.

By definition, if a space requires Level C or B PPE during entry, or if the work conducted within the space can create a hazardous situation, then the alternate procedures cannot not be used. (Note: The use of respiratory protection may only be used when first opening the entrance cover if an exposure to a hazardous atmosphere is possible. Respiratory protection should be discontinued once forced air ventilation has eliminated the atmospheric hazards.)

(1) Review all available information to ensure alternate procedures can be used for entry into the space. If any hazards exist or can be generated, aside from atmospheric, (e.g., engulfment, entrapment,

electrical, mechanical, any other serious safety or health hazard), these procedures cannot be used. (See Section G.13.0 - General Entry Procedures).

(2) All workers must have certificates stating that they have attended a Confined Space Entry training course.

(3) Inspect and calibrate all pieces of equipment to ensure they are in good working condition. DO NOT ENTER A CONFINED SPACE WITH DEFECTIVE EQUIPMENT!

(4) Evaluate the conditions around the entrance cover to the confined space. Any existing conditions that make it unsafe to remove the cover must be eliminated. These conditions include both chemical and physical hazards.

(5) Once the entrance cover is removed, the entryway shall be immediately guarded by a railing, temporary cover, danger tape, or some other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

(6) Monitor the breathing zone and then the entryway in the following order: 1) oxygen; 2) LEL; and 3) toxic chemicals. When monitoring for toxic chemicals, use one or any combination of the following meters as appropriate: PID, FID, Hydrogen Sulfide Meter, and/or Draeger tubes. Other meters may also be used as appropriate. NOTE: If there is a potential for high concentrations of ,]]i (above the PEL/TLV) then respiratory protection during this stage is mandatory.

(7) Monitor the internal atmosphere (top, middle, and bottom) for the following in the order given: 1) oxygen; 2) LEL, 3) toxic chemicals. If the largest reading is:

1. ≤ 19.5 % Oxygen
2. ≥ 10 % LEL
3. ≥ ½ PEL/TLV

than the space must be ventilated using forced air ventilation. If all the readings (top, middle, and bottom) within the space are within acceptable ranges for entry, than entry can be conducted without ventilation.

(8) If forced air ventilation is required, it must be directed so as to ventilate the immediate area(s) where associates are working and will continue until all associates have left the confined space.

(9) The air supply for the forced air ventilation must be from a clean source, and not located near running vehicles, motors, or some other sources of contamination.

(10) The atmosphere within the space must be periodically tested, as necessary, to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. In addition,

as the exhaust for the contaminated air will more than likely be through the entryway, the breathing zone of any workers standing outside the space should also be periodically monitored to ensure the levels are within acceptable ranges.

(11) If a hazardous atmosphere is detected during entry, each associate must leave the space immediately and the space evaluated to determine how the hazardous atmosphere developed. Measures must then be taken to prevent a reoccurrence of the situation leading to the development of the hazardous atmosphere before allowing any subsequent entry. If a reoccurrence cannot be prevented, entry must then be conducted using a permit in compliance with the entire Permit-Required Confined Spaces standard.

(12) The HSO must verify that the space is safe for entry and that all the required measures have been take. Once verification has taken place, the HSO will ensure all sections of the Confined Space Entry - Alternate Procedures form is completed and has his/her signature certifying the space is safe for entry.

(13) All entrants are required to review and sign the Confined Space Entry - Alternate Procedures form.

The following sections of the Permit-Required Confined Spaces standard are <u>not</u> required when using the Alternate Procedures:

- A written Permit-Required Confined Space Program.
- The establishment of a permit system.
- The use of an Entry Permit.
- Specific training and responsibilities for an Entrant.
- Specific training and responsibilities for an Attendant.
- Specific training and responsibilities foe an Entry Supervisor.
- Specific training and responsibilities for Rescue and Emergency personnel.

DEFINITIONS AND ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ANSI	American National Standards Institute
Atmosphere	Refers to the gases, vapors, mists, fumes, and dusts within a confined space.
Attendant	The individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program
Blanking/Blocking	The absolute closure of a pipe, line, or duct by fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
Ceiling Level	The maximum airborne concentration of a toxic agent to which an employee may be exposed for a specified period of time.
CO	carbon monoxide
Combustible Dust	A dust capable of undergoing combustion or burning when subjected to a source of ignition.
Confined Space	A space that is large enough and so configured that an associate can bodily enter and perform assigned work; has limited or restricted means for entry or exit; and is not designed for continuous use. Confined spaces include, but are not limited to, storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.
Confined Space, Class "A"	A confined space that presents situations that are IDLH. These include, but are not limited to, oxygen deficiency, explosive or flammable atmospheres, and/or concentrations of toxic substances.
Confined Space, Class "B"	A confined space that has the potential for causing injury and illness, if preventive measures are not used, but not IDLH.
Confined Space, Class "C"	A confined space in which the potential hazard would not require any special modification of the work procedure.

CPR	Cardiopulmonary Resuscitation
Double Block and Bleed	The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
Engulfment	The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.
Entry	The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuring work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.
Entry Supervisor	The person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by 1910.146. (Note: the Entry Supervisor may also serve as the attendant or as an authorized entrant as long as that person is trained and equipped as required for each role he/she/fills.)
HASP	Health and Safety Plan
HSO	Health and Safety Officer
HSM	Health and Safety Manager
HSS	Health and Safety Supervisor
Hot Work	Any work involving burning, welding, riveting, or similar fire-producing operations, as well as work that produces a source of ignition (e.g., drilling, abrasive blasting, and space heating).
IDLH	Immediately Dangerous to Life and Health
Inerting	Displacement of the atmosphere by a nonreactive gas (e.g., nitrogen) to such an extent that the resulting atmosphere is noncombustible.
Isolation	A process whereby the confined space is removed from service and completely protected against the inadvertent release of material by the following: blanking off (skillet type metal blank between flanges),

	misaligning sections of all lines and pipes, a double block and bleed system, electrical lock-out of all sources of power, and blocking or disconnecting all mechanical linkages.
Lower Explosive Limit (LEL)	The minimum concentration of a combustible gas or vapor in air (usually expressed in percentage by volume at sea level), which will ignite if any ignition source (sufficient ignition energy) is present.
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
Oxygen Deficiency	Refers to an atmosphere with a partial pressure of oxygen (PO_2) less than 132- mm Hg. Normal air at sea level contains approximately 21 percent oxygen at a PO_2 of 160-mm Hg. At an altitude of 5,280 feet, normal air contains approximately 21 percent O_2 at a PO_2 of 132-mm Hg.
Oxygen-enriched Atmosphere	Any oxygen concentration greater than 23.5 percent (PO_2 190-mm Hg) at normal atmospheric pressure.
Permissible Exposure Limit (PEL)	The maximum 8-hour, TWA of any airborne contaminant which an employee may be exposed. At no time shall the exposure level exceed the ceiling concentration for that contaminant, as listed in 29 CFR Part 1910 Subpart Z.
Permit-Required Confined Space	A confined space that has one or more of the following characteristics: 1) contains or has a potential to contain a hazardous atmosphere; 2) contains a material that has the potential for engulfing an entrant; 3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or 4) contains any other recognized serious safety or health hazard.
PID	Photoionization Detector
ppm	parts per million
Prohibited Condition	Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.
psi	pounds per square inch
Purging	The method by which gases, vapors, or other airborne impurities are displaced from a confined space.

Respirator (Approved)	A device that has met the requirements of 30 CFR Part 11, is designed to protect the wearer from inhalation of harmful atmospheres, and has been approved by the Bureau of Mines and NIOSH, and the Mine Safety and Health Administration (formerly, Mining Enforcement and Safety Administration).
SCBA	self-contained breathing apparatus
Standby Person	A person trained in emergency rescue procedures, assigned to remain outside the confined space and to be in communication with those working inside.
Threshold Limit Value (TLV)	The maximum 8-hour, TWA of any airborne contaminant to which an employee may be exposed as recommended by the American Conference of Governmental Industrial Hygienists.
TWA	time-weighted average

CONFINED SPACE ENTRY PERMIT

CONFINED SPACE ENTRY PERMIT
29 CFR 1910.146

Site Name:_____ Site Location:_____

Purpose of Entry:_____

Contaminants:_____

Type of Confined Space:_____

Date and Time of Entry:_____ Date and Time Permit Expires_____

POTENTIAL HAZARDS: (Check all that apply)

[ ]	Flammable	[ ]	Moving Parts	[ ]	Radioactive	[ ]	Entrapment
[ ]	O_2 Deficiency	[ ]	Valves & Pipes	[ ]	Noise	[ ]	Engulfment
[ ]	Toxic	[ ]	Electrical	[ ]	Heat	[ ]	Other _____

EQUIPMENT REQUIRED: (Check all that apply)

[X]	LEL/O_2 Meter	[X]	Safety Harness	[ ]	Level A	[X]	Standby SCBA
[ ]	PID	[X]	Lifeline	[ ]	Level B	[ ]	Ladder
[ ]	FID	[ ]	Hoist	[ ]	Level C	[ ]	Barrier and shield
[ ]	Draeger Tubes	[ ]	Ventilation	[ ]	Mod. Level D	[ ]	Radio
[ ]	Hydrogen Sulfide	[ ]	Lighting	[ ]	Level D	[ ]	Cellular Telephone
[ ]	Other:_____						

ACCEPTABLE ATMOSPHERIC LEVELS FOR ENTRY:

≥19.5%	= Oxygen	_____	= PID/FID
<10%*	= LEL	_____	= Draeger Tube _____
<10%	= Hydrogen Sulfide Meter	_____	= Other _____

*May use <20% LEL as long as precautions are taken (e.g., non-sparking tools, intrinsically safe equipment)

ATMOSPHERE TESTING RESULTS:

Record time and results of readings at Entryway (prior to opening door or cover), Initial atmosphere (greatest of top, middle or bottom of space), when atmosphere has Stabilized after ventilation (greatest of top, middle, or bottom of space), and periodically thereafter in the worker's Breathing Zone.

	Entryway	Initial*	Stabilized	Breathing Zone	Breathing Zone	Breathing Zone	Breathing Zone
Time							
% Oxygen							
% LEL							
H_2S Meter (ppm)							
PID/FID (ppm)							
Draeger Tube (ppm) Tube:							
Other (list)							

*If initial readings are acceptable, workers can enter space in Level D or Modified Level D withhout ventilation.

CONFINED SPACE ENTRY PERMIT
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Yes	No	N/A	
			All identified atmospheric and physical hazards are controlled.
			All hazards introduced by the work performed are addressed (e.g., welding fumes).
			Air intake of the ventilation system is located in an area free of contaminants.
			Valves, pipes, and mechanical and electrical equipment has been locked – out, blocked chocked, disengaged or otherwise disconnected where necessary.
			All required equipment and rescue equipment is present and in good working condition.
			Non – sparking tools and intrinsically safe equipment and lighting are used if required.
			All monitoring instruments have been properly calibrated.
			All workers have initial confined space entry training certification.
			All workers receive site specific confined space entry training.
			Rescue team members practiced rescue operations in space or similar space. Practice Date:_____
			All rescue team members certified in first aid and CPR.
			Entry coordinated with subcontractors.

N/A – Not Applicable

DESCRIPTION OF RESCUE PROCEDURES:

PROBLEMS ENCOUNTERED: Was rescue required?___

SIGNATURES:

I have reviewed the work authorized by this permit and the information contained here – in. Written instructions and safety procedures have been received and understood. I understand that this permit is not valid and the permit cannot be approved and entry conducted if any of the above squares are marked "NO" or if required sections are incomplete.

Entrants: _____ _____
Attendants: _____ _____
Rescue Team: _____ _____
Other: _____ _____

Permit prepared by: _____
Entry Authorized by (HSO): (Print)_____ (Signature)_____

PERMIT CANCELLATION:

Reason: _____
HSO Signature: _____

☐ Copy of form sent to Health and Safety Manager, Portland, ME. (mandatory)

MANHOLE/SEWER ENTRY PERMIT

MANHOLE/SEWER ENTRY PERMIT
29 CFR 1910.146

Site Name:_____ Site Location:_____

ose of Entry:_____ Date and Time of Entry:_____

ACCEPTABLE ATMOSPHERIC LEVELS FOR ENTRY:

≥19.5%	= Oxygen	_____	= PID/FID
≤10%*	= LEL	_____	= Draeger Tube _____
≤10%	= Hydrogen Sulfide Meter	_____	= Other _____

*May use <20% LEL as long as precautions are taken (e.g., non-sparking tools, intrinsically safe equipment)

EQUIPMENT REQUIRED: (Check all that apply)

X	LEL/O_2 Meter	X	Safety Harness		Level A	X	Stand by SCBA
	PID	X	Lifeline		Level B		Ladder
	FID	X	Hoist		Level C		Barrier and shield
	Draeger Tubes		Ventilation		Mod. Level D		Radio
	Hydrogen Sulfide		Lighting		Level D		Cellular Telephone
	Other:_____						

ATMOSPHERE TESTING RESULTS:

Record time and results of readings at Entryway (prior to opening door or cover), Initial atmosphere (greatest of top, middle or bottom of space), when atmosphere Stabilizes after ventilation (greatest of top, middle, and space), and periodically thereafter in the workers Breathing Zone.

	Entryway	Initial*	Stabilized	Breathing Zone	Breathing Zone	Breathing Zone	Breathing Zone
Time							
% Oxygen							
% LEL							
H_2S Meter (ppm)							
PID/FID (ppm)							
Draeger Tube (ppm)							
Other (list)							

*If initial readings are acceptable, workers can enter space in Level D or Modified Level D without ventilation.

DESCRIPTION OF RESCUE PROCEDURES:

Full chest of body harness with retrieval line connected in the center of back at shoulder level or above entrants head. Retrieval line will be connected to tripod with hoisting device. Non-entry retrieval will be conducted. If entry for rescue is required, workers will don Level B PPE.

MANHOLE/SEWER ENTRY PERMIT
29 CFR 1910.146

Yes	No	N/A	
			All identified atmospheric and physical hazards are controlled.
			All hazards introduced by the work performed are addressed (e.g., welding fumes).
			Air intake of the ventilation system is located in an area free of contaminants.
			All required equipment and rescue equipment is present and in good working condition.
			Non-sparking tools and intrinsically safe equipment and lighting are used if required.
			All monitoring instruments have been properly calibrated.
			All workers have initial confined space entry training certification.
			All workers received site specific confined space entry training.
			Rescue team members practiced rescue operations in space or similar space.
			Practice Date:_____
			All rescue team members certified in first aid and CPR.
			Entry coordinated with subcontractors.

PROBLEMS ENCOUNTERED:

_____

_____

_____

_____

Was rescue required?____

SIGNATURES:

I have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures have been received and understood. I understand that this permit is not valid and the permit cannot be approved and entry conducted if any of the above squares are marked "NO" or if required sections are incomplete.

Entrants: _____ _____

Attendants: _____ _____

Rescue Team: _____ _____

Other: _____ _____

Permit prepared by: _____

Entry Authorized by (HSO): (Print)_____ (Signature)_____

PERMIT CANCELLATION:

Reason: _____

_____

HSO Signature: _____

☐ Copy of form sent to Health and Safety Manager, Portland, ME. (manditory)

CONFINED SPACE ENTRY - ALTERNATE PROCEDURES FORM

CONFINED SPACE ENTRY – ALTERNATE PROCEDURES
29 CFR 1910.146

Alternate procedures can only be used for confined spaces where ABB–ES has demonstrated, through monitoring and inspection that: 1) the only hazard posed by the space is an actual or potential hazardous atmosphere; and 2) Continuous forced air ventilation alone is sufficient to ensure that the space is safe for entry

Site Name: _____ Date of Entry: _____
Site Location: _____ Location Confined Space: _____
Justification for using alternate procedures: _____

YES	NO	N/A	
			1. Do condition exist making it unsafe to open entrance cover? (If yes, unsafe conditions must be eliminated before the cover is removed!)
			2. Has entrance been protected? (e.g., railing, danger tape, etc.) Method being used: _____
			3. Internal atmosphere tested with direct reading instruments? (Record results below)
			4. Atmosphere acceptable for entry? (If no, continuous forced air ventilation is manditory!)
			5. Is continuous forced air ventilation being used? (No entry allowed until atmospheric conditions are safe.)
			6. Are the immediate areas where associates are or will be present being ventilated? (If no, move ventilation.)
			7. Is the air supply for the forced air ventilation from a clean source? (If no, provide a clean source of air.)

ACCEPTABLE ATMOSPHERIC LEVELS FOR ENTRY:

> 19.5%	=	Oxygen	_____	=	PID/FID
< 10%	=	LEL	_____	=	Draeger Tube: _____
< 10%	=	Hydrogen Sulfide	_____	=	Other: _____

* May use < 20% LEL as long as precautions are taken (e.g., non–sparking tools, intrinsically safe equipment)

ATMOSPHERE TESTING RESULTS: (NOTE: Monitoring must be conducted in the order listed below.) Record the time and the results of readings at the Entryway (prior to opening the door or cover), Initial atmosphere (greatest of top, middle, or bottom of space), when the atmosphere has Stabilized after ventilation (greatest of top, middle, or bottom of space), and periodically thereafter in the workers Breathing Zone.

	Entryway	Initial*	Stabilized	Breathing Zone	Breathing Zone	Breathing Zone	Breathing Zone
Time							
% Oxygen							
% LEL							
H_2S Meter (ppm)							
PID/FID (ppm)							
Draeger Tube (ppm) Tube:							
Other (list)							

* If initial readings are acceptable, workers can enter space in Level D without ventilation.

I certify that all safety precautions have been taken and that conditions are safe for entry.

Signiture of HSO: _____ Date: _____

I [illegible]y that I have reviewed the information provided and the space has been certified as safe for entry.

Signature of Entrants: _____ Date: _____
_____ Date: _____

APPENDIX J EXCAVATION AND TRENCHING

APPENDIX J EXCAVATION AND TRENCHING

J.1 EXCAVATION PROCEDURES

Because excavations and trenches pose a hazard to employees, structures, and equipment, all excavations created during site operations will be done in accordance with 29 CFR 1926 Subpart P. The following steps summarize the excavation procedures that will be followed by all ABB-ES personnel:

- Prior to excavating or trenching, all surface encumbrances located so as to create a hazard to the employees will be removed or supported, and all underground utilities will be determined and located.

- Entry into excavations will be avoided at all costs. If entry is unavoidable, the excavation will be considered a confined space; as such, entry will be done in accordance with the Confined Space Entry Program (see Appendix I).

- Under no circumstances will site personnel enter excavations that are not adequately protected from cave-ins by shoring or sloping.

- Stairways, ladders, or ramps will be located in trenches deeper than 4 feet and situated to require no more than 25 feet of lateral travel.

- Excavations below the base of a building or structure will not be permitted unless the building or structure is adequately supported or a registered professional engineer determines that the excavation will not pose a hazard to the employee.

- All equipment will be kept at least 2 feet from the edge of the excavation.

- Any excavation left open and unattended will be barricaded or covered until it can be backfilled.

J.2 SLOPING

Acceptable options for sloping or benching include the following:

Option 1. A slope of 1½ horizontal to 1 vertical (34 degrees measured from the horizontal).

Option 2. Determination of the maximum allowable slope based on soil conditions and in accordance with the conditions and requirements set forth in 1926 Subpart P, Appendices A and B (see Attachment A).

Option 3. Designs of sloping or benching systems using tabulated data approved by a registered professional engineer.

Option 4. Other systems designed by a registered professional engineer.

J.3 SHORING

Acceptable options for shoring include the following:

Option 1. Designs using Appendices A, C, and D of 1910.126 Subpart P (see Attachment A).

Option 2. Designs using manufacturers tabulated data.

Option 3. Designs using tabulated data approved by a registered professional engineer.

Option 4. Other support systems designed by a registered professional engineer.

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APPENDICES A THROUGH D

OCCUPATIONAL SAFETY AND HEALTH STANDARDS - EXCAVATIONS

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

(g) *Shield systems*—(1) *General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Appendix A to Subpart P

Soil Classification

(a) *Scope and application*—(1) *Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in § 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in § 1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653–85 and D2488; The Unified Soils Classification System; The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS–12.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 tsf per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements*—(1) *Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses

shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be examined individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the sides of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as ⅛-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of ⅛-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure)".) Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

Appendix B to Subpart P

Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and raveling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and moving or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements.*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slopes.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B–1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.652(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B–1.

TABLE B-1

MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK TYPE A [2] TYPE B TYPE C	VERTICAL (90°) 3/4 : 1 (53°) 1:1 (45°) 1½: 1 (34°)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

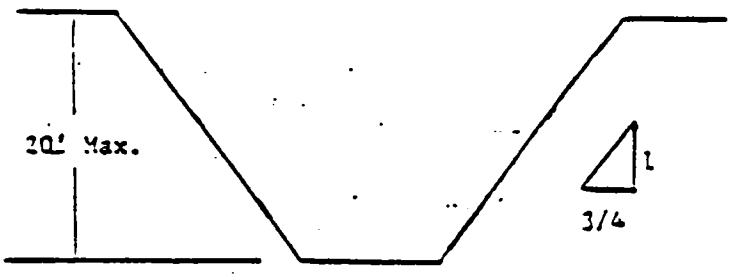
Figure B-.

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

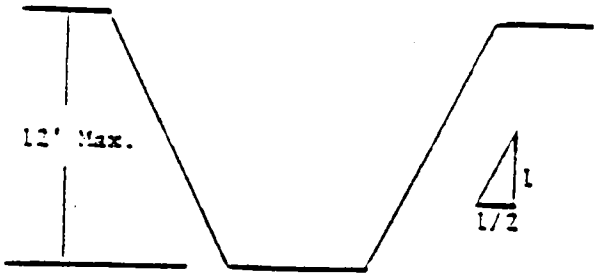
B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



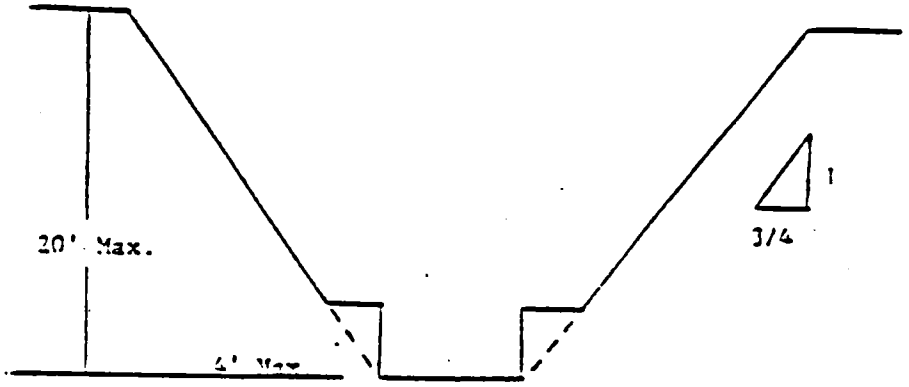
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1.

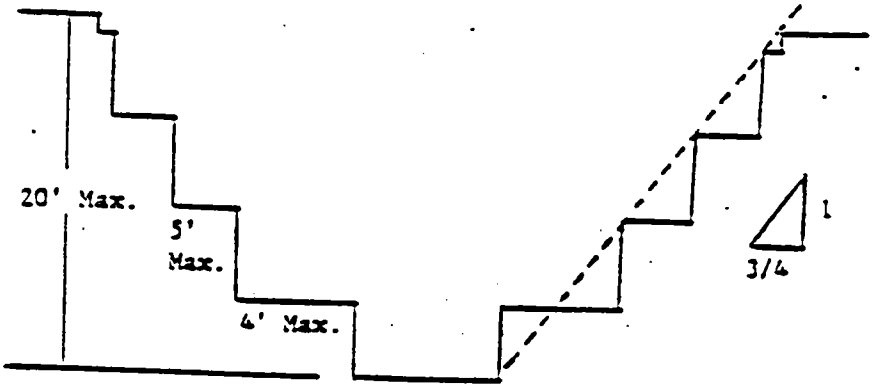


Simple Slope—Short Term

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows:

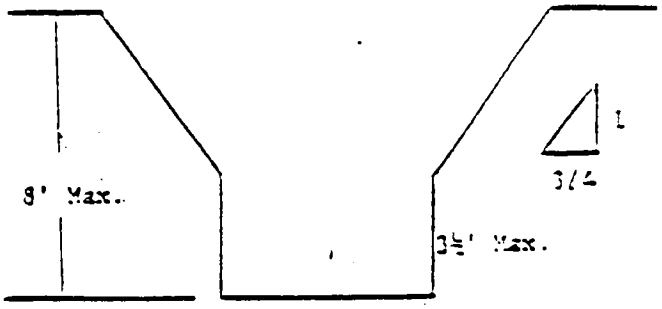


Simple Bench



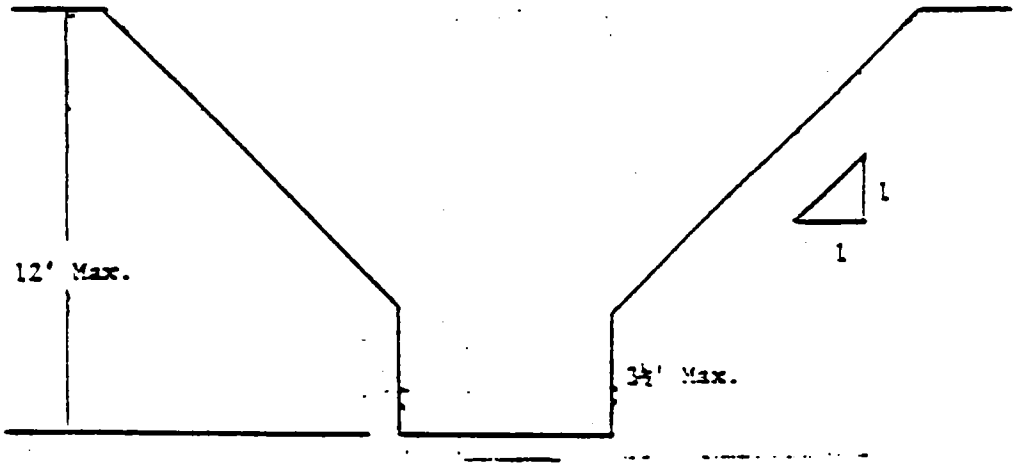
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



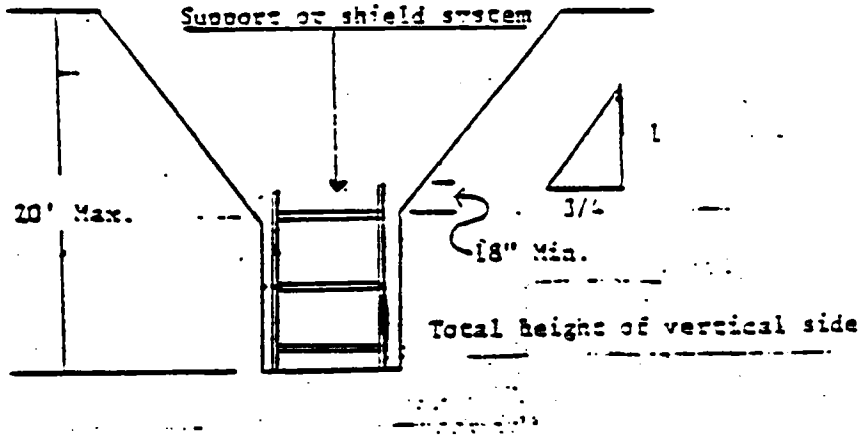
Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.



Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

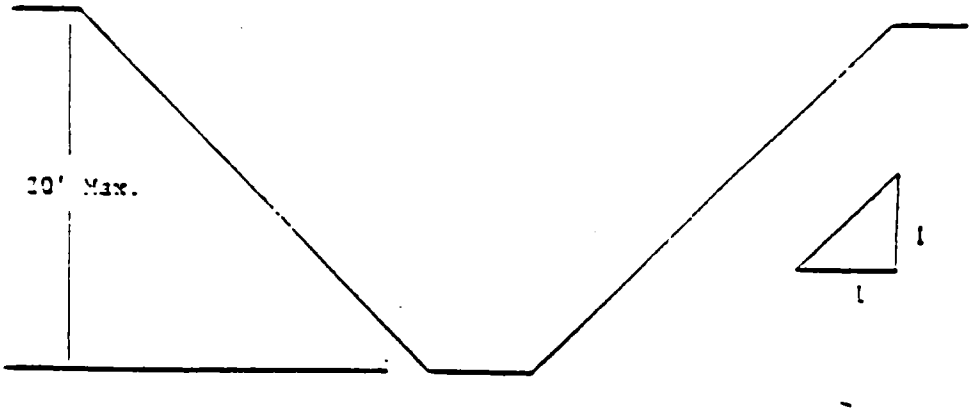


Supported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

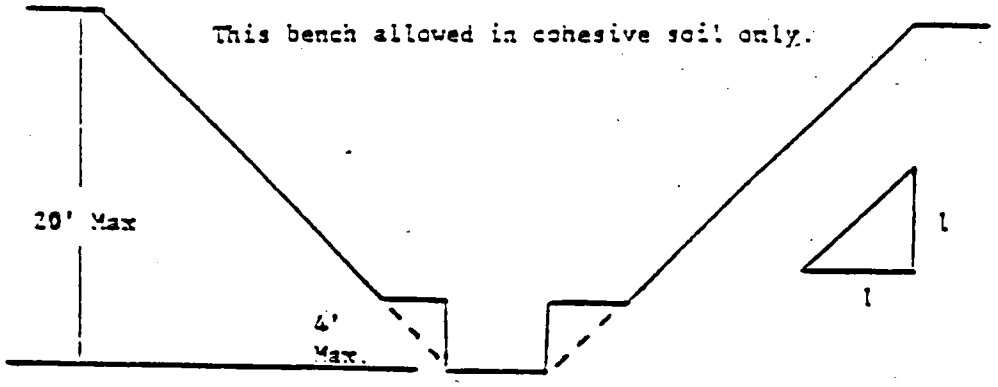
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

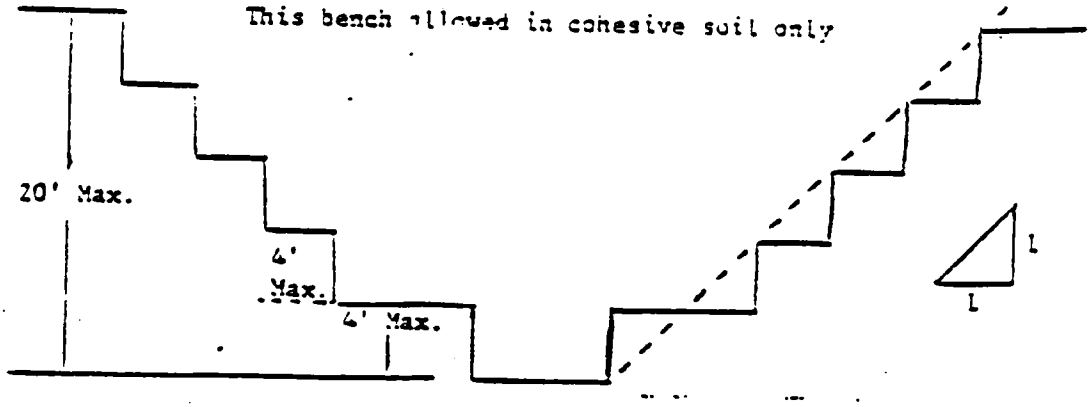


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

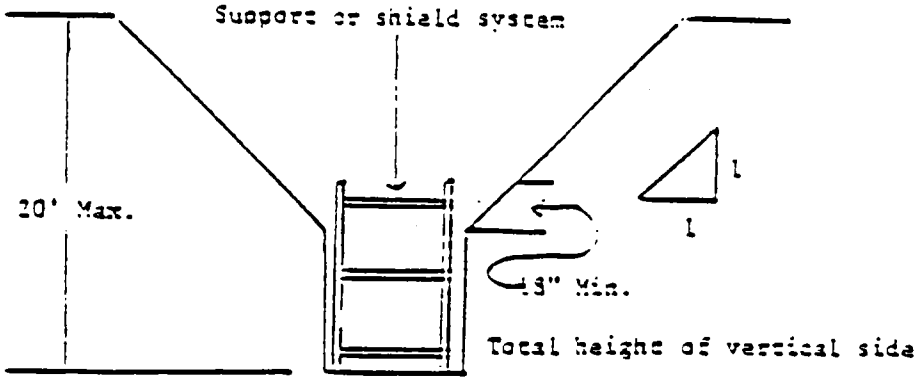


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

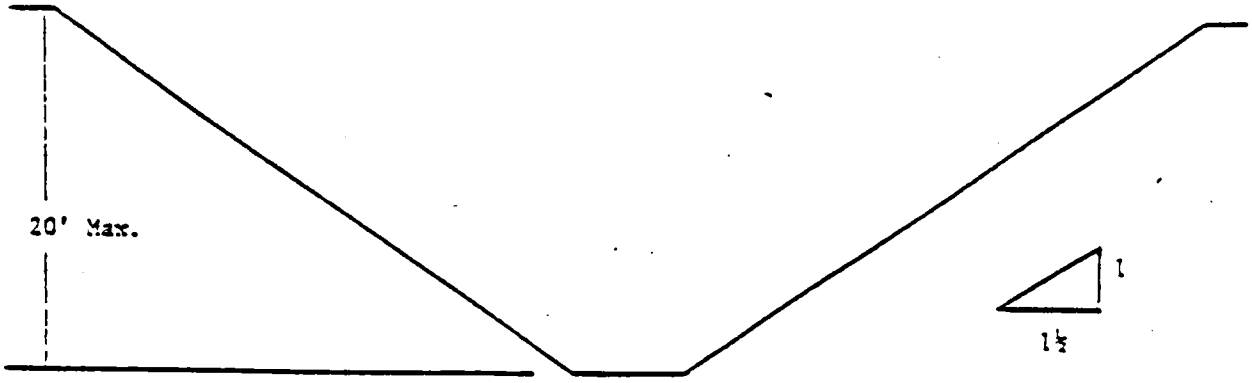


Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

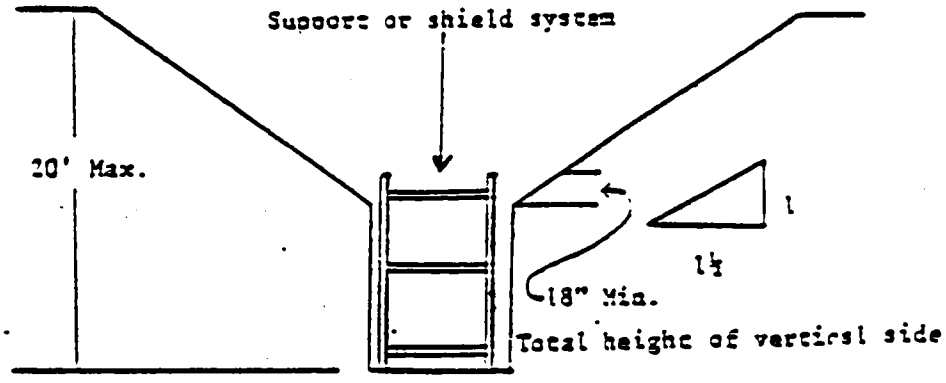
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.

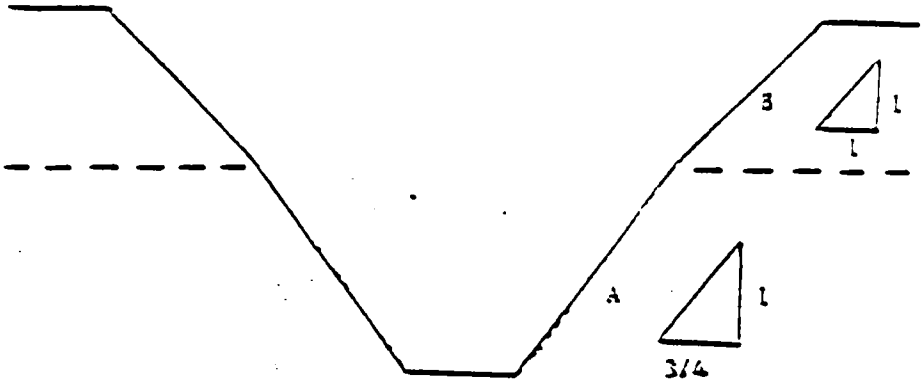


Vertical Sided Lower Portion

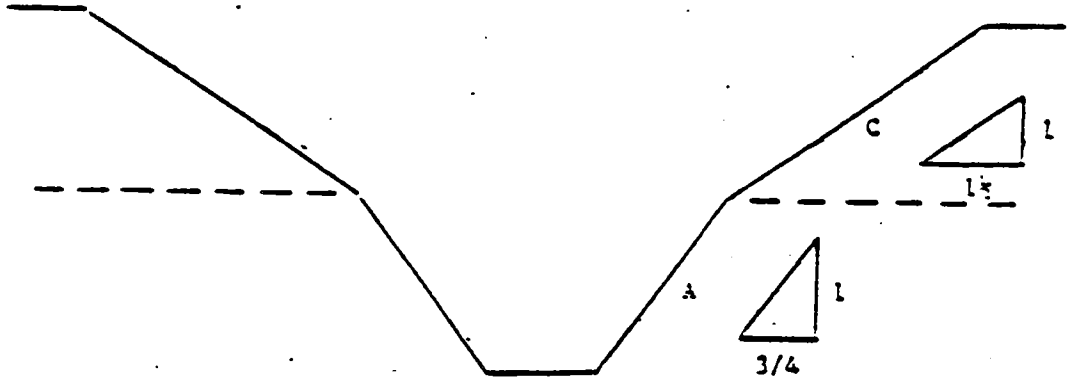
3. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

B-1.4 Excavations Made in Layered Soils

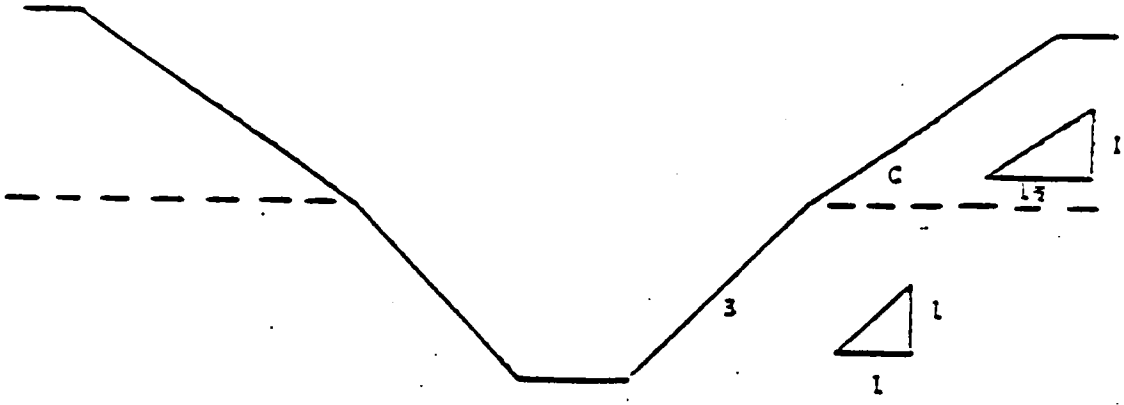
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



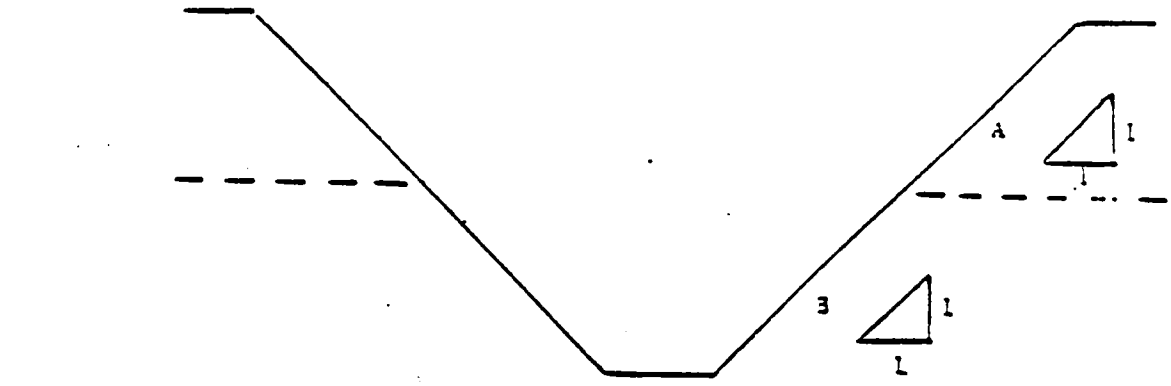
B OVER A



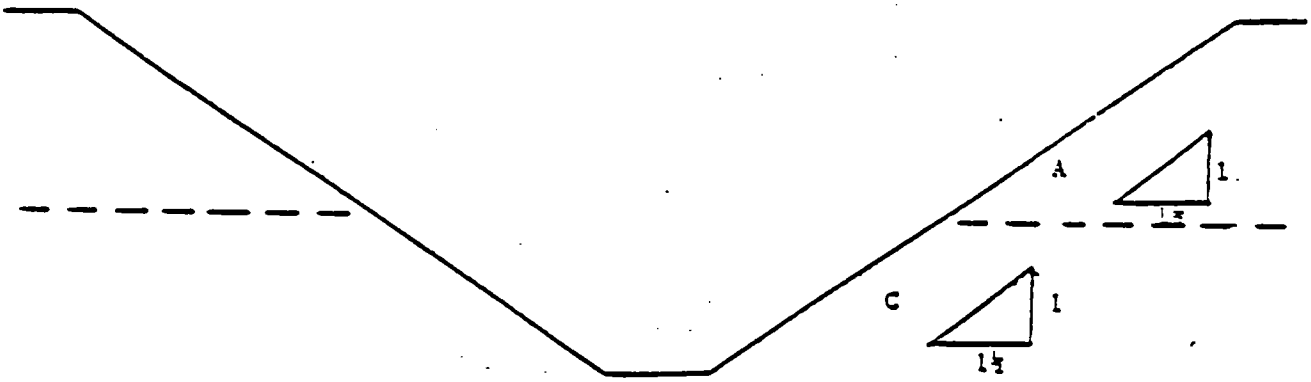
C OVER A



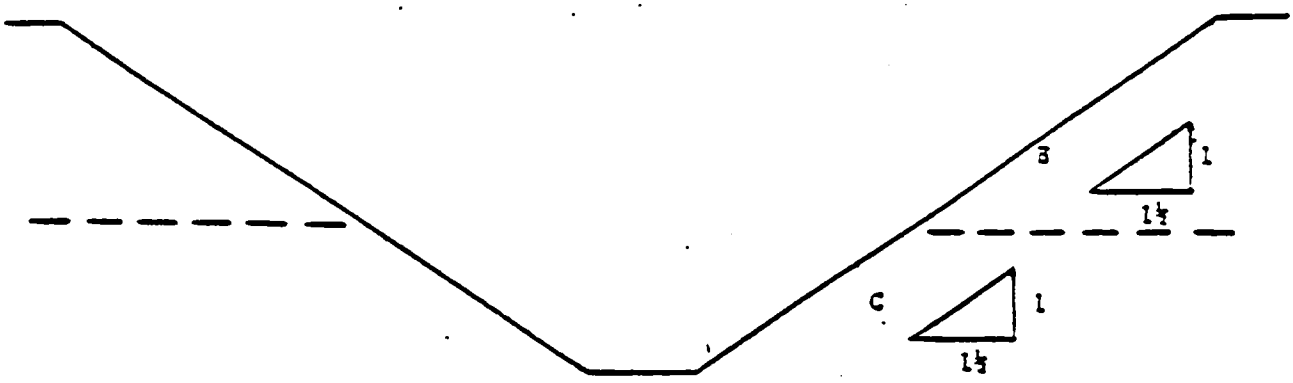
C OVER B



A OVER B



A OVER C



B OVER C

2. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in § 1926.652(b) and § 1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2 and C-1.3 and Tables C-2.1, C-2.2 and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 12 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

Arrangement #3

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

Arrangement #4

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Spaces 3×8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C-1.2 three acceptable arrangements of members are listed.

Arrangement #1

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #2

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #3

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C-1.3 two acceptable arrangements of members can be used.

Arrangement #1

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C-1.3. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of Tables C-2.1 through C-2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in § 1926.652(c), "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 30 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

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TABLE C-1.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A P_a = 25 X H + 72 psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				2X6	
	UP TO 8	4X4	4X4	4X5	6X6	6X6	4	Not Req'd	---					2X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			2X6		
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4				2X6	
10 TO 15	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---					3X8
	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6			
	UP TO 10	6X6	6X6	6X6	6X8	6X8	4	8X10	4			2X6		
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4				3X8	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6				
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3		
5 TO 10	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5			2X6		
	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5			2X6		
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5			2X6		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5		2X6			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5		2X6			
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5		2X6			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	3X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	3X6				
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C P_a = 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES									UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
10 TO 15	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed Oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A P_a = 25 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **												
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X4	4X4	4X6	4	Not Req'd	Not Req'd				4X6	
	UP TO 8	4X4	4X4	4X4	4X6	4X6	4	Not Req'd	Not Req'd					4X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			4X6		
	UP TO 12	4X6	4X6	4X6	6X6	6X6	4	8X8	4				4X6	
10 TO 15	UP TO 6	4X4	4X4	4X4	6X6	6X6	4	Not Req'd	Not Req'd				4X10	
	UP TO 8	4X6	4X6	4X6	6X6	6X6	4	6X8	4		4X6			
	UP TO 10	6X6	6X6	6X6	6X6	6X6	4	8X8	4			4X8		
	UP TO 12	6X6	6X6	6X6	6X6	6X6	4	8X10	4		4X6		4X10	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X6	6X6	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X6	6X6	4	8X8	4	3X6	4X12			
	UP TO 10	6X6	6X6	6X6	6X6	6X8	4	8X10	4	3X6				
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	8X12	4	3X6	4X12			
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
		CROSS BRACES						WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6
5 TO 10	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5			3X12 or 4X8		4X12
	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8	
	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10			
	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	6X8	8X8	5	8X10	5	4X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C P_a = 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	CROSS BRACES						WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
5 TO 10	UP TO 6	6X6	6X6	6X6	6X6	8X8	5	8X8	5	3X6				
	UP TO 8	6X6	6X6	6X6	8X8	8X8	5	10X10	5	3X6				
	UP TO 10	6X6	6X6	8X8	8X8	8X8	5	10X12	5	3X6				
	See Note 1													
10 TO 15	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	10X10	5	4X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8X8	8X8	8X8	8X10	8X10	5	10X12	5	4X6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

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Appendix D to Subpart P

Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with § 1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D–1.1, D–1.2, D–1.3 and D–1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D–1.1 and D–1.2 are for vertical shores in Types A and B soil. Tables D–1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D–1.1 through D–1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D–1 Tables. Aluminum material is 6061–T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with § 1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D–1.1, D–1.2, D–1.3 and D–1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D–1.1 and D–1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D–1.3 and D–1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables.*

(1) Example 1:

A trench dug in Type A soil is 8 feet deep and 3 feet wide. From Table D–1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 12 feet deep and 5 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 18 feet deep and 9 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically. plywood (per footnote (g)(7) to the D–1 Tables) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D–1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D–1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D–1.1, D–1.2, D–1.3, and D–1.4.*

(1) For applications other than those listed in the tables, refer to § 1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to § 1926.652(c)(2) and § 1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5×3.5×0.375) oversleeves, or structural oversleeves of manufacturer's specification, extending the full collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

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ALUMINUM HYDRAULIC SHORING
TYPICAL INSTALLATIONS

FIGURE NO. 1

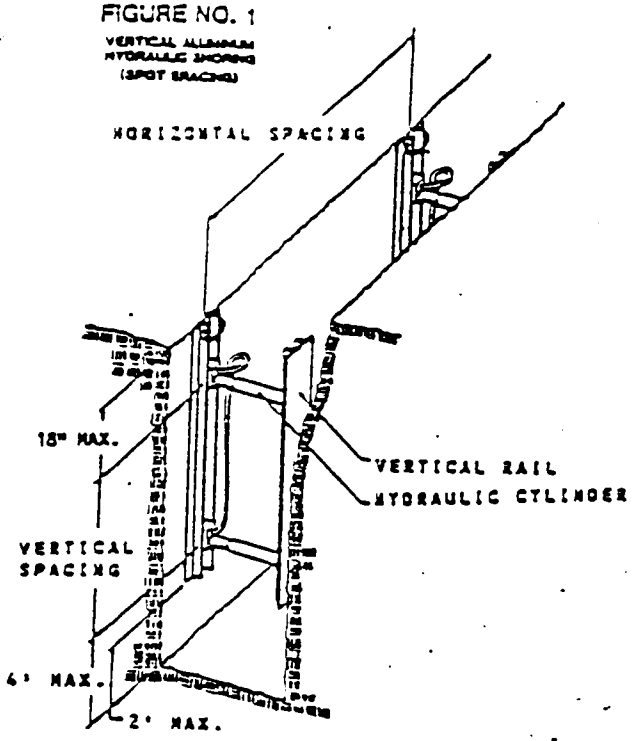


FIGURE NO. 2

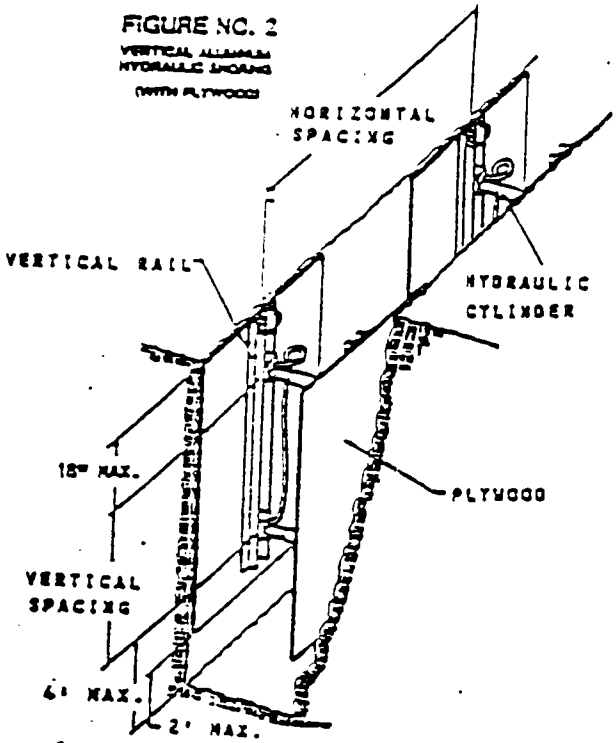


FIGURE NO. 3

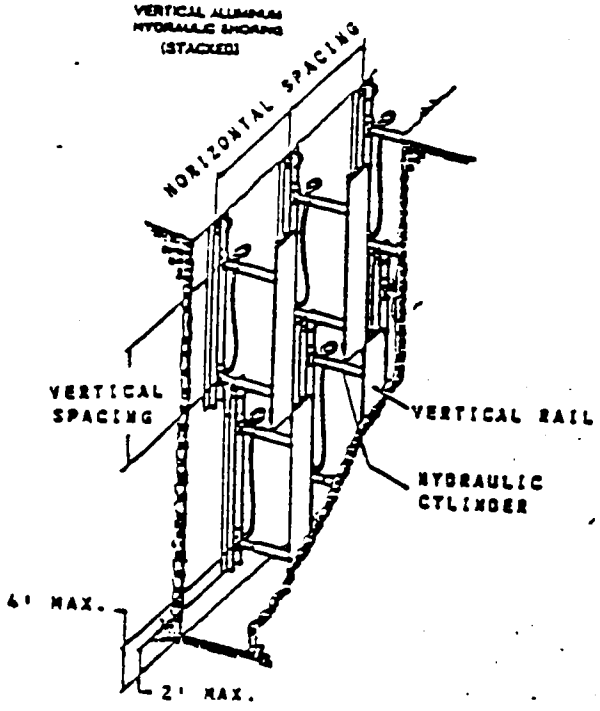


FIGURE NO. 4

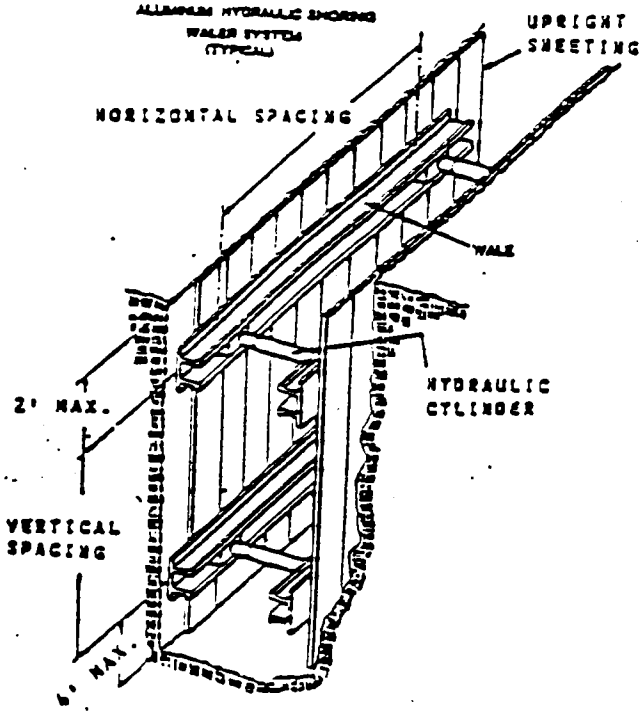


TABLE D - 1.1
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	7				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX. HORIZ. SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15				
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN³) *	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	SOLID SHEET	2 FT.	3 FT.
OVER 5 UP TO 10	4	3.5	8.0	2 IN	8.0	2 IN NOTE(2)	8.0	3 IN	—	—	3x12
		7.0	9.0	2 IN	9.0	2 IN NOTE(2)	9.0	3 IN			
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN			
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	—	3x12	—
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	2 IN NOTE(2)	5.5	3 IN	3x12	—	—
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX HORIZ SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15				
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN³)	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	SOLID SHEET	2 FT.	3 FT.
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	3x12	—	—
		7.0	6.5	2 IN	6.5	2 IN NOTE(2)	6.5	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN	3x12	—	—
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN			
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN	3x12	—	—
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN			
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, Item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

Appendix E to Subpart P—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

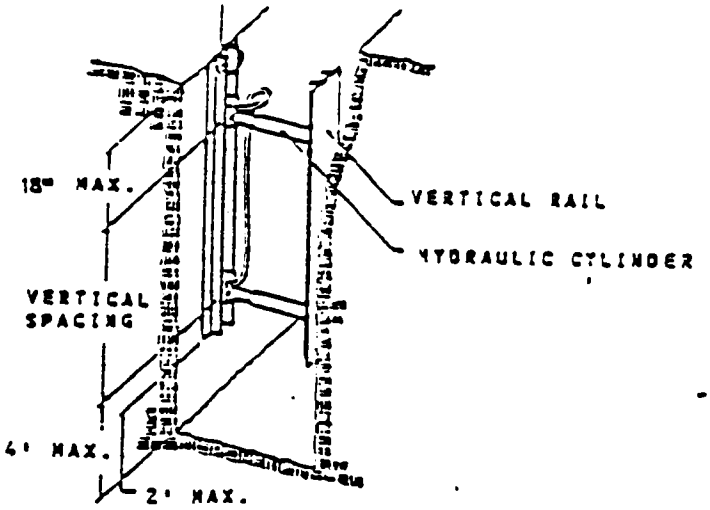
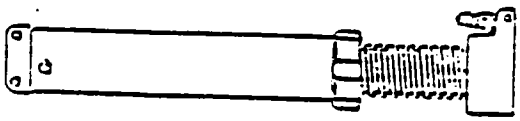


Figure 2. Pneumatic/hydraulic Shoring



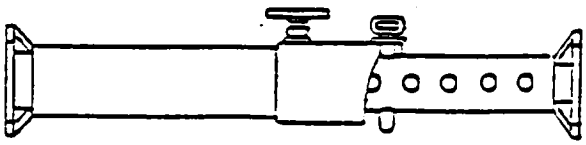


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Figure 3. Trench Jacks (Screw Jacks)

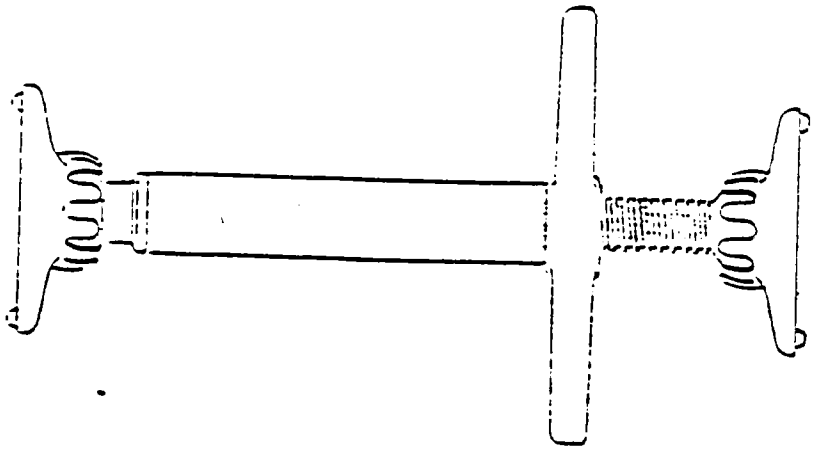
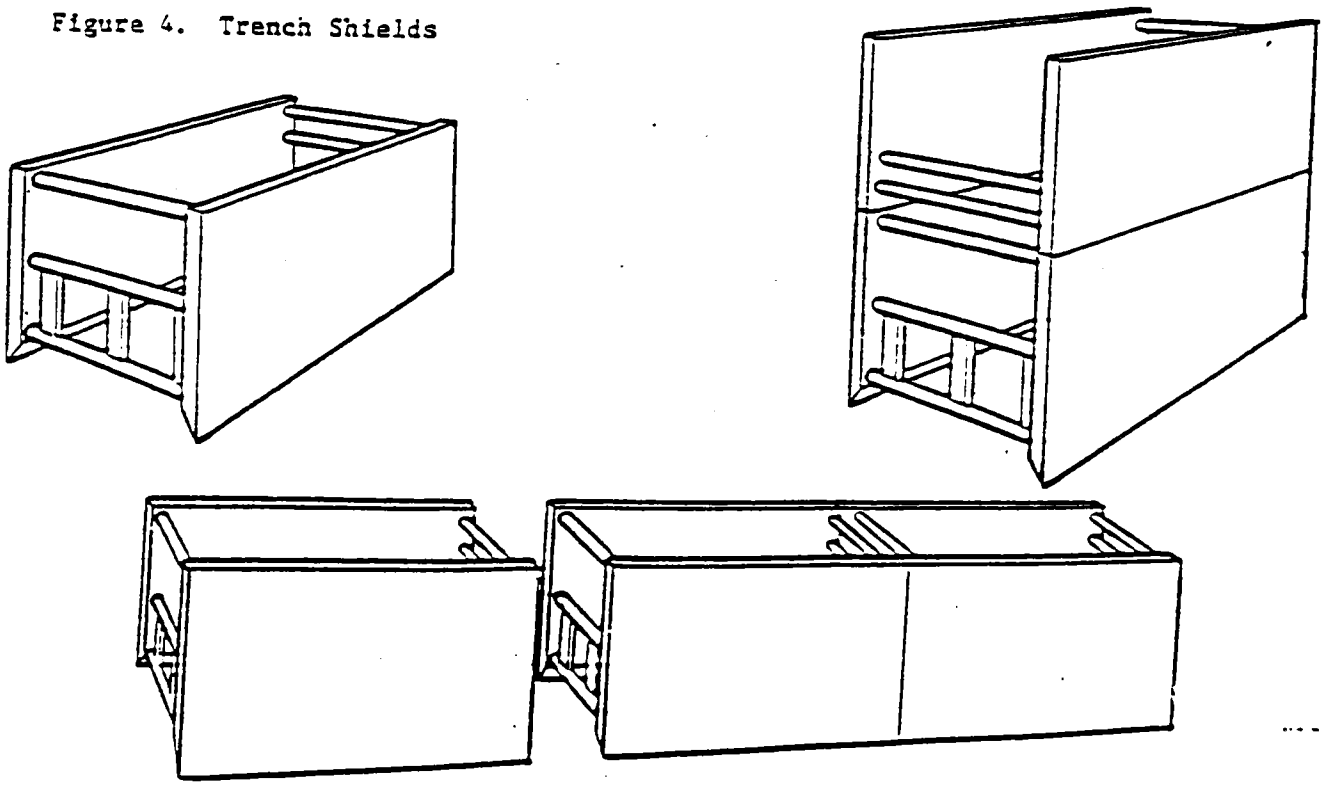


Figure 4. Trench Shields



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Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with § 1926.652 (b) and (c).

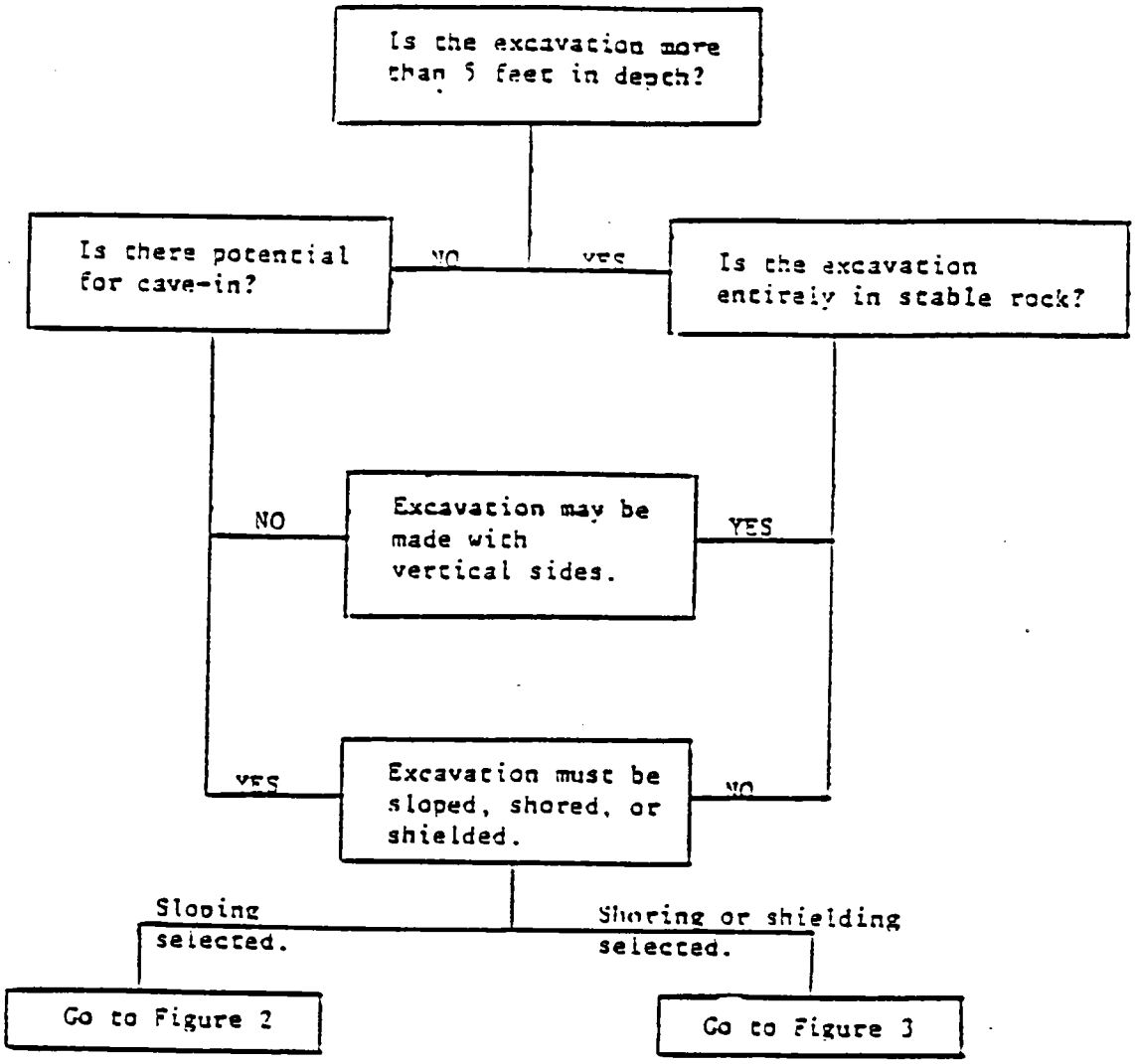

FIGURE 1 - PRELIMINARY DECISIONS

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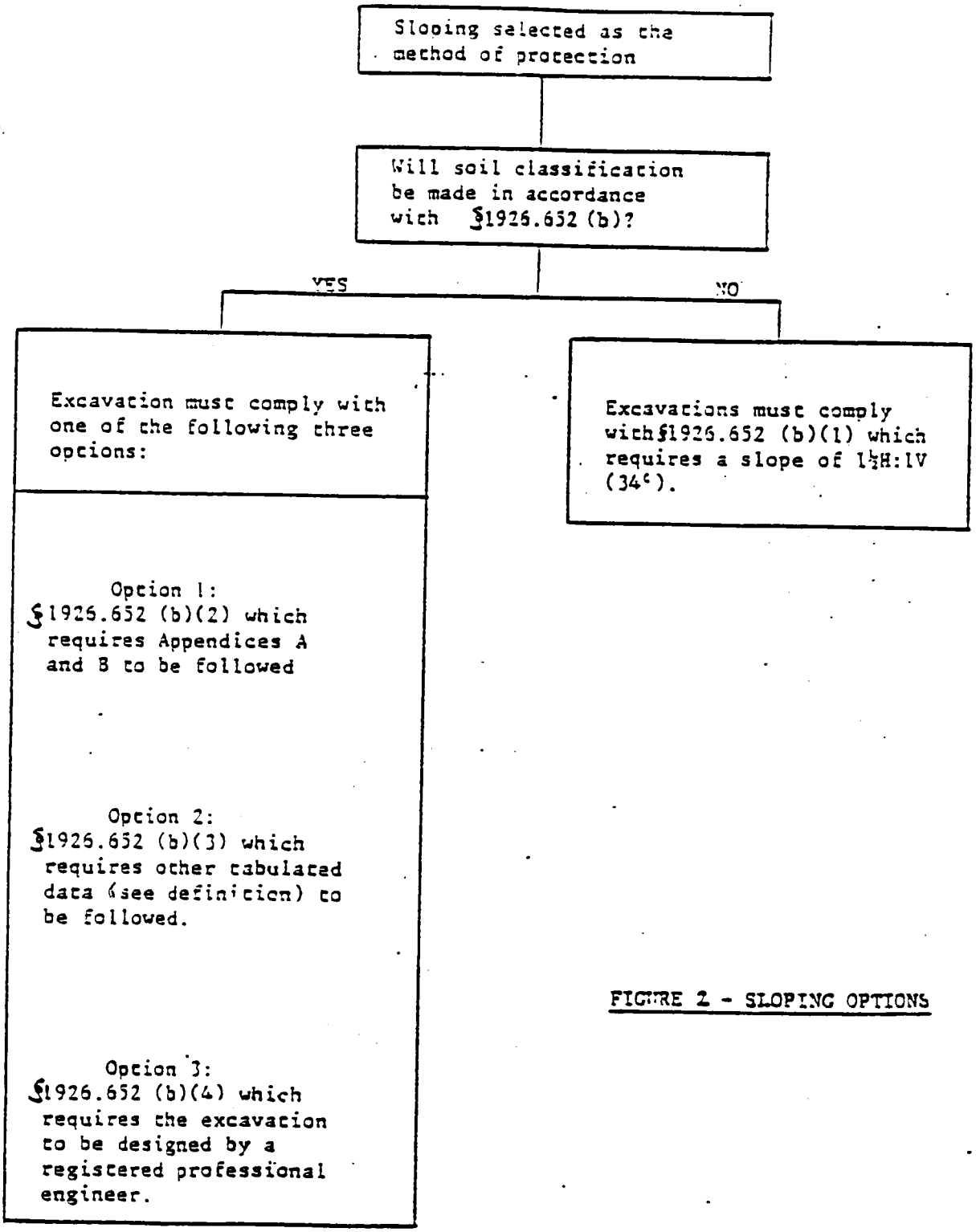


FIGURE 2 - SLOPING OPTIONS

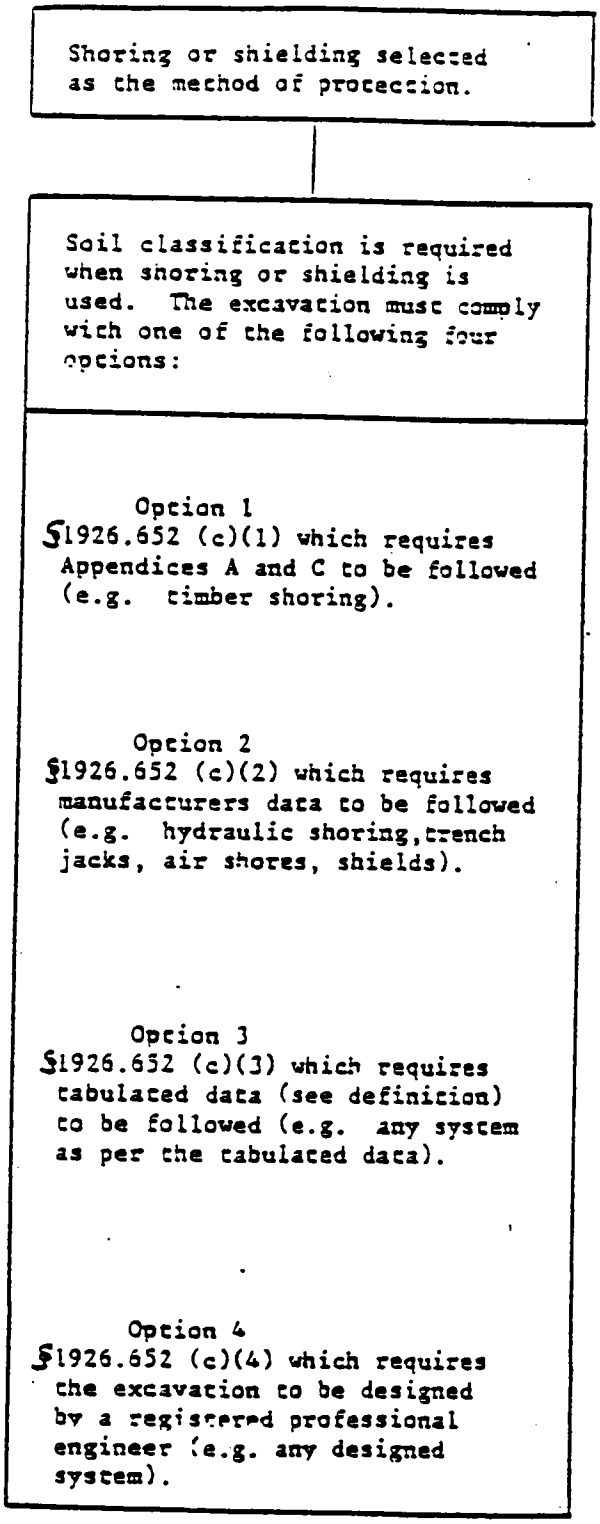


FIGURE 3 - SHORING AND SHIELDING OPTIONS

[FR Doc. 89-25217 Filed 10-30-89; 8:45 am]
BILLING CODE 4510-26-C

APPENDIX K TEMPERATURE EXTREMES

APPENDIX K TEMPERATURE EXTREMES

K.1 HEAT STRESS

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there is increased potential for injury, specifically heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and the prevention of heat stress casualties.

K.1.1 Identification and Treatment

K.1.1.1 Heat Exhaustion.

Symptoms. Heat exhaustion usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, the skin is clammy, and he or she may perspire profusely. The pulse is weak and fast; breathing is shallow. The victim may faint unless he or she lies down. This may pass; however, sometimes it persists and, while heat exhaustion is generally not considered life threatening, death could occur.

First Aid. Immediately remove the victim to the CRZ in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock (i.e., have the victim lie down, raise the feet 6 to 12 inches, and maintain body temperature but loosen all clothing). If the victim is conscious, it may be helpful to give sips of water. Transport the victim to a medical facility.

K.1.1.2 Heat Stroke.

Symptoms. This is the most serious of heat casualties because the body excessively overheats. Body temperatures often are between 107 and 110°F. The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

First Aid. Immediately evacuate the victim to a cool and shady area in the CRZ. Remove all protective outer wear and all personal clothing. Lay the victim on his or her back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels or ice bags to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place the victim in a tub of cool water. The main objective is to cool without chilling. Do not give stimulants. Transport the victim to a medical facility as soon as possible.

K.1.2 Prevention of Heat Stress

One of the major causes of heat casualties is the depletion of body fluids and salts through sweating. Fluids should be maintained in the Support Zone. Salts can be replaced by either a 0.1 percent salt solution, more heavily salted foods,

or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low-sodium diets.

During warm weather, a work schedule will be established that allows most work to be conducted during the morning hours, before ambient air temperature levels reach highs.

A work/rest schedule will be implemented for personnel required to wear Level B or C protection (i.e., an impervious outer garment) with sufficient time allowed for personnel to "cool down" (this may require working in shifts). Two hours is the maximum time between breaks at Level B or C, regardless of temperature. At elevated temperatures, breaks should be scheduled as follows:

Ambient Temperatures	Maximum Time Between Cool Down Breaks
Above 90°F	¼ hour
85° to 90°F	½ hour
80° to 85°F	1 hour
70° to 80°F	1½ hours

K.1.3 Heat Stress Monitoring

Monitoring of personnel wearing impervious clothing should commence when the ambient temperature reaches 70°F, with increased frequency if ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85°F, workers should be monitored for heat stress after every work period. As a screening mechanism of the body's recuperative ability to excess heat, one or more of the following techniques should be used.

1. Measure the heart rate (HR) for 30 seconds, by radial pulse, as early in the resting period as possible. At the beginning of the rest period, the HR should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the pulse rate is still above 110 beats per minute at the beginning of the next rest period, the following work cycle should again be shortened by 33 percent.

2. Measure oral body temperature with a clinical thermometer, as early as possible in the resting period. At the beginning of the rest period, oral temperature (OT) should not exceed 99°F. If OT exceeds 99°F, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the OT again exceeds 99°F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should also be measured at the end of the rest period to ensure that it has dropped below 99°F.

3. Maintain good hygienic standards by changing clothes frequently, showering daily, and allowing clothing to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

K.2 COLD STRESS

Cold weather may often cause problems for personnel working outside, even at temperatures above freezing. As temperatures drop below freezing, the potential for cold weather injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0°F (-18°C) or if the windchill factor drops below -29°F (-34°C). These levels represent guidelines that should be used as an action level unless the HSO determines and documents otherwise. Table K-1, which shows equivalent temperatures (i.e., windchill) for a range of ambient conditions, should also be referred to.

Snow and ice increase the risks to personnel and operations through reduced visibility, increased potential for falling injuries, reduced on-site mobility, and the increased time required to access the site (or off-site support services).

In view of these factors, it is critical that the HSO establish site-specific safety and operating protocols, and that all on-site personnel be made aware of the risks.

K.2.1 Local Cold Injuries

Local cold injuries affect specific areas of the body (e.g., fingers, ears, or toes), including the more commonly recognized injuries described in the following subsections.

K.2.1.1 Chilblains. Chilblains is a chronic condition affecting the skin and peripheral capillary circulation, resulting from prolonged exposure of the bare skin, primarily in the extremities, to temperatures at or below 60°F. The best method of preventing and treating chilblains is to cover and protect the skin, thereby avoiding prolonged exposure to the cold.

K.2.1.2 Frostbite. Frostbite is freezing of the hands, feet, ears, and exposed parts of the face as a result of exposure to very low temperatures. Frostbite occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur.

There are three stages of frostbite: incipient frost bite (frostnip), superficial frostbite, and deep frostbite. The classification depends on severity and can range from incipient frostbite (frostnip), which affects the skin; to superficial frostbite, which involves the skin and the tissues immediately beneath it; to deep frostbite, which is much more serious with damage that may affect deeper tissue and even bone.

Symptoms. Symptoms for each of the three stages of frostbite are described as follows.

- Frostnip. Skin first turns red and then later becomes pale or waxy white. There may be tingling, stinging, aching, an uncomfortable sensation of coldness or numbness, or no noticeable symptoms.
- Superficial Frostbite. The skin turns white or gray-white and is waxy in appearance. It is firm to touch (i.e., does not move

TABLE K-1
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED
AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

HEALTH AND SAFETY PLAN
PART II

ESTIMATED WIND SPEED (in mph)	ACTUAL TEMPERATURE READING (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	EQUIVALENT CHILL TEMPERATURE (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148

(Wind speeds greater than 40 mph have little additional effect.)

LITTLE DANGER
In <hour with dry skin. Maximum danger of false sense of security.

INCREASING DANGER
Danger from freezing of exposed flesh within 1 minute.

GREAT DANGER
Flesh may freeze within 30 seconds.

Trenchfoot and immersion foot may occur at any point on this chart.

Source: Developed by U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts.

easily) and the tissue beneath the skin is soft and resilient. There is a lack of sensation in the area.

- Deep Frostbite. The tissue is pale, cold, and solid with possible blisters and swelling. The hands and feet are especially susceptible to deep frostbite.

Emergency Treatment of Frostbite. Frostnip is easily treated in the field by the application of body heat, which should be applied before the affected area becomes numb. If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it. Thaw frozen spots immediately. Do not rub affected areas.

Superficial frostbite usually responds to the application of body heat, as described previously. If the skin does not respond to body heat or if it resembles the early stages of deep frostbite, follow the emergency treatments listed in the following paragraphs. DO NOT rub affected areas.

For deep frostbite, if possible, the injured person should be taken to a heated shelter to avoid further frostbite. If it can be done without the danger of further frostbite, remove all constricting items (e.g., boots, gloves, and socks) from the injured area. RAPID REWARMING WILL MINIMIZE TISSUE LOSS. If possible, warm the extremities in a carefully controlled water bath (104 to 106°F) until tips of the fingers or toes turn pink and feeling is restored. If a water bath is not available, either apply wet packs (100 to 112°F) to the person's body, or gently wrap frostbitten area in blankets or some other warm material.

DO NOT attempt to thaw the affected parts by exercising them or heating them in front of an open fire, heat lamp, radiator, or stove. The person could receive a heat injury as a result of sensation loss.

DO NOT use snow to thaw frostbite. DO NOT rub, massage, or use pressure on the affected areas. Keep the frostbitten parts elevated if possible. Watch to see if CPR is necessary. Give the victim warm drinks such as tea, coffee, or soup. DO NOT GIVE ALCOHOLIC BEVERAGES. Have the victim exercise fingers or toes as soon as possible, but only after they are warmed. DO NOT allow a person with frostbitten feet to walk; walking may cause additional damage.

Medical Treatment of Frostbite.

- Frostnip. Usually does not require medical care.
- Superficial Frostbite. Blisters may require medical care.
- Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Transport the victim to medical care facilities at once.

Prevention of Frostbite. It is far easier to prevent or stop frostbite in earlier stages than to thaw and take care of badly frozen flesh. To protect the body against frostbite, the following precautions should be taken:

- Wear enough clothing to protect against the cold and wind.

- Wear warm gloves and boots.
- Pull a scarf or jacket flap over the lower part of the face or pull a hood tightly around the face.
- Occasionally exercise the face, fingers, and toes to keep them warm and to detect any areas that may have become numb.
- Crew members should watch each other closely, especially the face, for signs of frostbite.

K.2.1.3 **Immersion Foot**. Immersion foot (formerly called trenchfoot) is a cold injury resulting from prolonged exposure to near-freezing temperatures when standing or walking on wet or swampy ground.

Symptoms. In the early stages, the feet and toes are pale, cold, numb, and stiff, and walking is difficult. If preventive action is not taken, the feet will swell and ache; in extreme cases, this may result in irreversible damage to the tissues of the foot or leg.

Emergency Treatment of Immersion Foot. Handle feet very gently. DO NOT rub or massage. If necessary, clean feet carefully with soap and warm water, then dry, elevate, and expose to warm but not hot air.

Prevention of Immersion Foot. Because the early stages of immersion foot are not painful, crew members must be constantly on the alert and check feet often when working in cold, wet conditions. Keep feet dry by wearing waterproof footgear and changing socks frequently because perspiration, trapped inside waterproof boots or heavy footgear, can contribute to immersion foot symptoms. Avoid standing in wet areas. If feet get wet, dry them as soon as possible, warm them with your hands, then use foot powder, and change to dry socks. If you cannot change wet boots and socks, exercise your feet frequently by wriggling your toes and moving your ankles. Never wear tight boots.

K.2.2 Systemic Cold Injuries

Systemic injuries are those that affect the entire body system. Severe body cooling, known as systemic hypothermia, can occur at temperatures well above freezing. Hypothermia, which can be fatal, is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold, and is aggravated by moisture, cold winds, fatigue, hunger, inadequate clothing or shelter, and excessive perspiration from strenuous exercise followed by too rapid cooling.

Hypothermia often occurs between temperatures of 30 to 50°F, which most people believe are not dangerous. Crew members should be alert for symptoms of hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow, or ice.

Hypothermia may occur on land or following submersion in even moderately cold water (i.e., 65°F or lower). On land, hypothermia may take a full day or more

of exposure to develop; however, if the conditions are extremely severe, death may occur within a few hours of initial symptoms.

In cold water, death may seem to be from drowning; in reality, it is usually the result of hypothermia. In water, skin and nearby tissues chill very fast; in 10 to 15 minutes, the temperature of the heart and brain may drop. When the core (i.e., internal body) temperature reaches 90°F, unconsciousness may occur; when body temperature drops to 80°F, heart failure is possible.

K.2.2.1 **Symptoms**. In the early stages of hypothermia, the body begins to lose heat faster than it can be produced, making an effort to stay warm by shivering. When the body can no longer generate enough heat to overcome heat loss and the energy reserves of the body become exhausted, body temperature begins to drop. This affects the ability of the brain to make judgments and also results in loss of muscular control. As the body temperature drops, hypothermia symptoms become increasingly severe, as shown in the following table:

SYMPTOMS OF HYPOTHERMIA	APPROXIMATE CORE TEMPERATURE
Person is conscious, alert with increased respiration. Shivering may become uncontrollable as core temperature nears 95°F.	Above 95°
Person is conscious but disoriented and apathetic. Shivering is present but diminishes as temperature drops. Below 92°F, respiratory rate gradually diminishes and pupils being to dilate.	95° to 90°F
Person is semiconscious. Shivering is replaced by muscular rigidity. Pupils are fully dilated at about 86°F.	90° to 86°F
Unconscious; diminished respiration.	Below 86°F
Barely detectable or nondetectable respiration.	Below 80°F

K.2.2.2 **Emergency Treatment of Hypothermia**. Move hypothermia victim to shelter and warmth as rapidly as possible. In very mild cases, dry clothing and shelter may be all that is needed. Gently remove all of the victim's wet clothing (so energy is not expended by warming and drying wet clothing) and replace it with a dry set. Give the person something warm to drink. DO NOT GIVE ALCOHOLIC BEVERAGES.

ALL OTHER HYPOTHERMIA CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES. PROVIDE EXTERNAL HEAT IN ANY WAY POSSIBLE! A warm bath (with the water kept between 105° and 110°F) is the most effective way of warming a victim of hypothermia. NEVER put an UNCONSCIOUS VICTIM in a bathtub.

If it is not possible to give the person a warm bath, use one of the following ALTERNATE METHODS:

- Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, and groin. As the packs cool, rewarm them by adding warm water (approximately 105°F). Check the temperature of the water with your elbow or the inside of your arm; it should be warm but not hot.

- If you are at a remote outdoor location and cannot use the other method, make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the victim.

DO NOT wrap a hypothermia victim in a blanket without an auxiliary source of heat unless it is to protect against any further heat loss before treatment can begin, or you need to go for help and there is no other alternative.

Continue treatment once the victim has stabilized. Give warm liquids and nourishing food if the person is conscious. Check the person for symptoms of frostbite and if necessary, give treatment.

Handle the patient gently and do not allow him or her to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop," in which the patient's core temperature drops below the level that will sustain life. ALCOHOL CONTRIBUTES TO AFTER-DROP.

K.2.2.3 **Medical Care for Hypothermia.** HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

K.2.2.4 **Prevention of Hypothermia.** In cold weather, never go into the field without wearing adequate clothing. Take a complete change of warm clothes and one or two extra pairs of socks (in plastic bags). Wear or carry a windproof, water-resistant outer jacket and, in rain or snow, wear adequate raingear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow, or immersion in water, change it as soon as possible. If you start to shiver in a prolonged or violent way, seek shelter at once. Shivering may produce heat but it also uses up energy. Violent shivering may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques. If you fall into water and you are not very close to shore, remain quiet. Keep your head out of water, climb onto the boat, or hold or climb onto any other object that will support you and keep you up out of the water.

K.2.3 **Safety/First Aid Equipment**

In view of the causes, results, and appropriate treatment of cold weather injuries discussed previously, as a minimum, the following safety equipment should be included during cold weather operations:

- extra clothing for all personnel

- blankets and/or sleeping bag

- high-energy food and drinking water supply
- toboggan
- tow ropes

In extreme cold conditions, add the following safety items:

- electric blanket (if an electrical source is available)
- portable emergency generator (with fuel, oil, and cords)
- space heater and fuel

K.2.4 General Winter Operations

Cold weather conditions can severely affect winter operations. The Site Manager and HSO must plan work schedules and project tasks accordingly.

K.2.4.1 Preliminary Assessment. If you will be working outdoors in cold weather, assess the local weather conditions through the news media (i.e., radio, television, and newspapers) to determine whether work should progress and/or the amount of preparation needed. Carefully consider questions such as the following:

- What are the typical wind and weather conditions for the period in which you will be working?
- Are the areas in which you will work sheltered or open to the wind?
- Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?
- Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?
- If you use a vehicle for a warming area or will use a heater in a closed room, how can you ensure there is adequate ventilation to prevent carbon monoxide poisoning?

K.2.4.2 Scheduling. Wherever possible, try to schedule work during the least severe weather. Rotate crew members to keep cold exposures short and allow sufficient time for frequent warming breaks. Remember that workers in heavy clothing often need more time to complete the tasks and may become fatigued more easily. Be aware that operations may have to be discontinued if winds increase or the temperature drops.

Because winter days are short, scheduling should allow time for taking care of equipment and supplies before nightfall. Once it becomes dark, it is more difficult to gauge terrain, and temperatures are likely to drop.

K.2.4.3 Site Access. Snow and ice could make travel on site access roads impossible, or treacherous at best. Personnel should not be allowed to work on-site if conditions could severely hamper the arrival or departure of emergency

vehicles. If the route to off-site medical facilities is blocked by snow or ice, an otherwise minor injury could result in a major medical emergency. If conditions warrant, the following provisions should be made:

- snow removal/plowing services for site access roads
- a dependable, four-wheel-drive vehicle available to on-site personnel for transporting an injured person to an off-site medical facility
- sleeping bags, blankets, a food supply, and water kept on-site in the event a sudden storm requires personnel to remain overnight

The HSO is responsible for deciding when weather conditions make site access unsafe, thereby requiring work to stop until conditions improve.

K.2.4.4 **Equipment and Supplies.** Obtain equipment and supplies that will help prevent cold stress and will help in the treatment of cold stress disorders. Required equipment includes a reliable ambient temperature thermometer, a wind gauge, and a windchill chart. If the site is potentially windy due to a lack of natural or manmade windbreaks (e.g., trees, valleys, and structures), try to provide means of shielding workers from the wind. If working at a remote location, carry extra food and water because hunger and dehydration contribute to cold stress. If possible, make provisions for hot food and beverages. Ensure that emergency communication equipment is available and operational for crew members working in the cold, at heights, or in remote locations.

Close attention must be given to the effects of cold weather on field equipment. Batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, a sufficient number of charging units, and a set of automotive jumper cables should be maintained on-site. In addition, the electronics in many field instruments such as PI, LEL, and oxygen meters, as well as the chemical reactions in detector tubes (e.g., Draeger tubes) can also be adversely affected by the cold. The manufacturers' literature must be consulted for minimum operating temperatures.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of relatively delicate pumps; long, uninsulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counter- productive. Portable shelters should be considered if cold weather sampling is necessary.

APPENDIX L DECONTAMINATION

APPENDIX L DECONTAMINATION

ABB-ES PROCEDURES

L.1 PERSONNEL DECONTAMINATION

Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the exclusion and contaminant reduction zones prior to decontamination. A typical personnel decontamination station is shown in Figure L-1. Generalized procedures for removal of protective clothing are as follows:

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets).

2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.

3. Scrub outer boots and outer gloves with decon solution or detergent and water. Rinse with water.

4. Remove tape from outer boots and remove boots; discard tape and boots in disposal container.

5. Remove tape from outer gloves and remove gloves; discard tape and gloves in disposal container.

6. If the worker has left the Exclusion Zone to change the air tank on the SCBA or the canister on the air-purifying respirator, this will be the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, and the joints taped; the worker then returns to duty.

7. Remove outer garments and discard in disposal container.

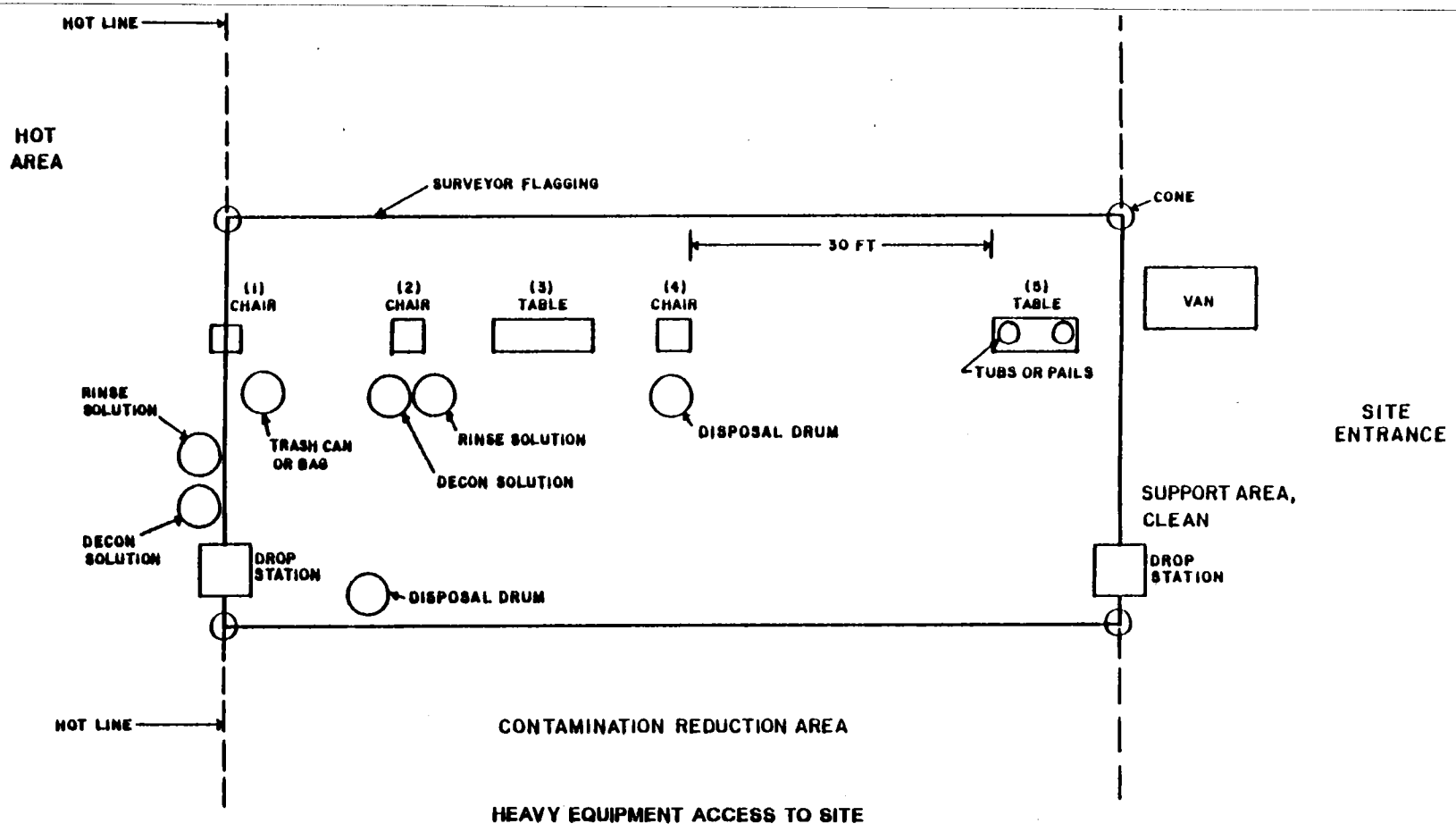
8. Remove respirator and place or hang in the designated area.

9. Remove inner gloves and discard in disposal container.

10. If the site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.

NOTE: Disposable items (i.e., Tyvek coveralls, inner gloves, and latex overboots) will be changed daily unless there is reason to change sooner. Dual respirator canisters will be changed daily, unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Maximum and minimum decontamination layouts for PPE Levels A through C are shown in Figures L-2 through L-6.



TASK

(1) WASH OUTER BOOTS - RINSE BOOTS - DISPOSE
(2) WASH OUTER GLOVES - RINSE GLOVES - DISPOSE
(3) SCBA TANK CHANGE OVER TABLE W/SPARE TANKS
(4) REMOVE OUTER GARMENT - DISPOSE
(5) REMOVE SCBA, WASH MASK IN PAILS OR TUBS
(6) REMOVE INNER GLOVES - DISPOSE

NOT TO SCALE

FIGURE L-1
TYPICAL PERSONNEL DECONTAMINATION STATION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

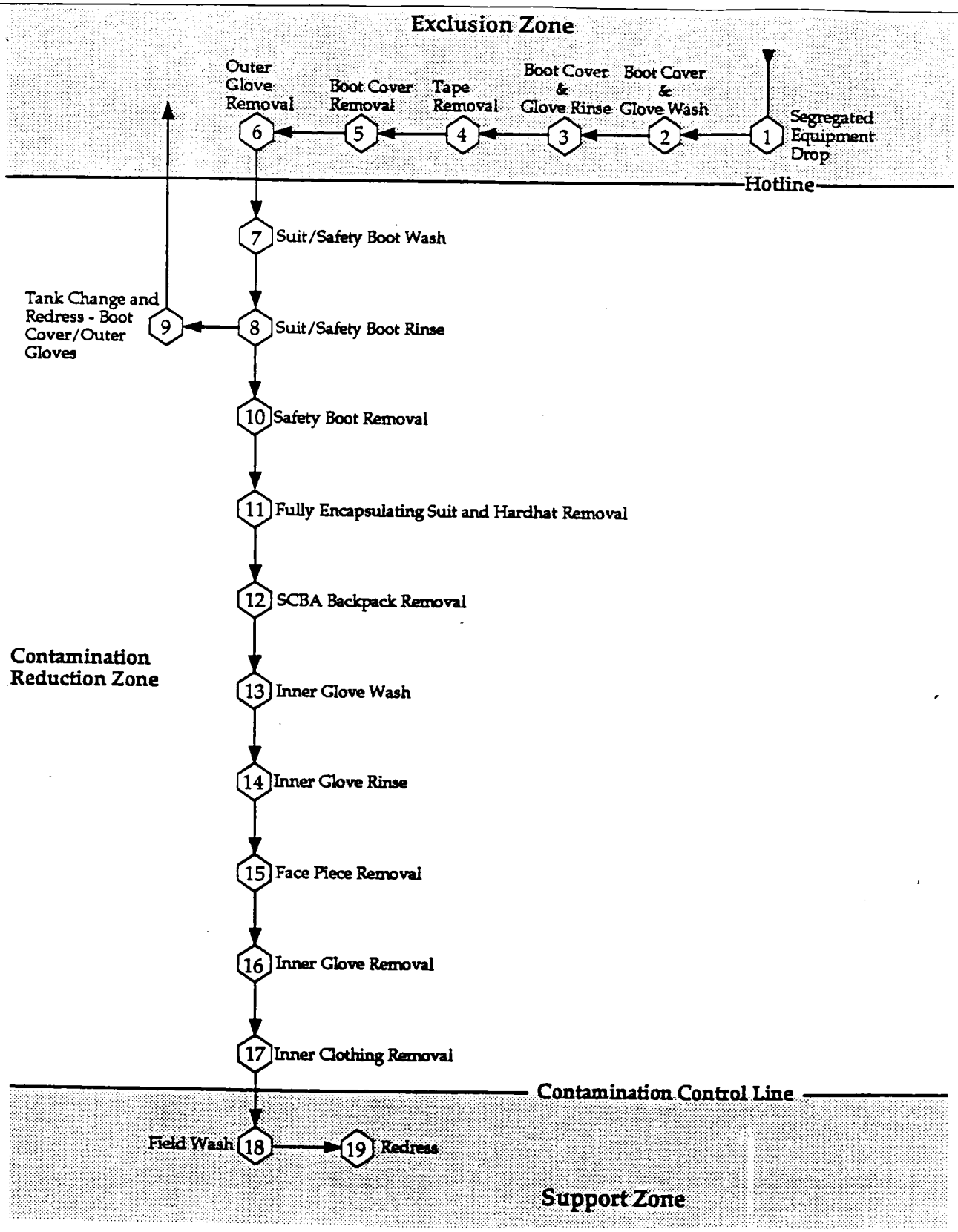


FIGURE L-2
MAXIMUM DECONTAMINATION LAYOUT
LEVEL A PROTECTION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

8519-23

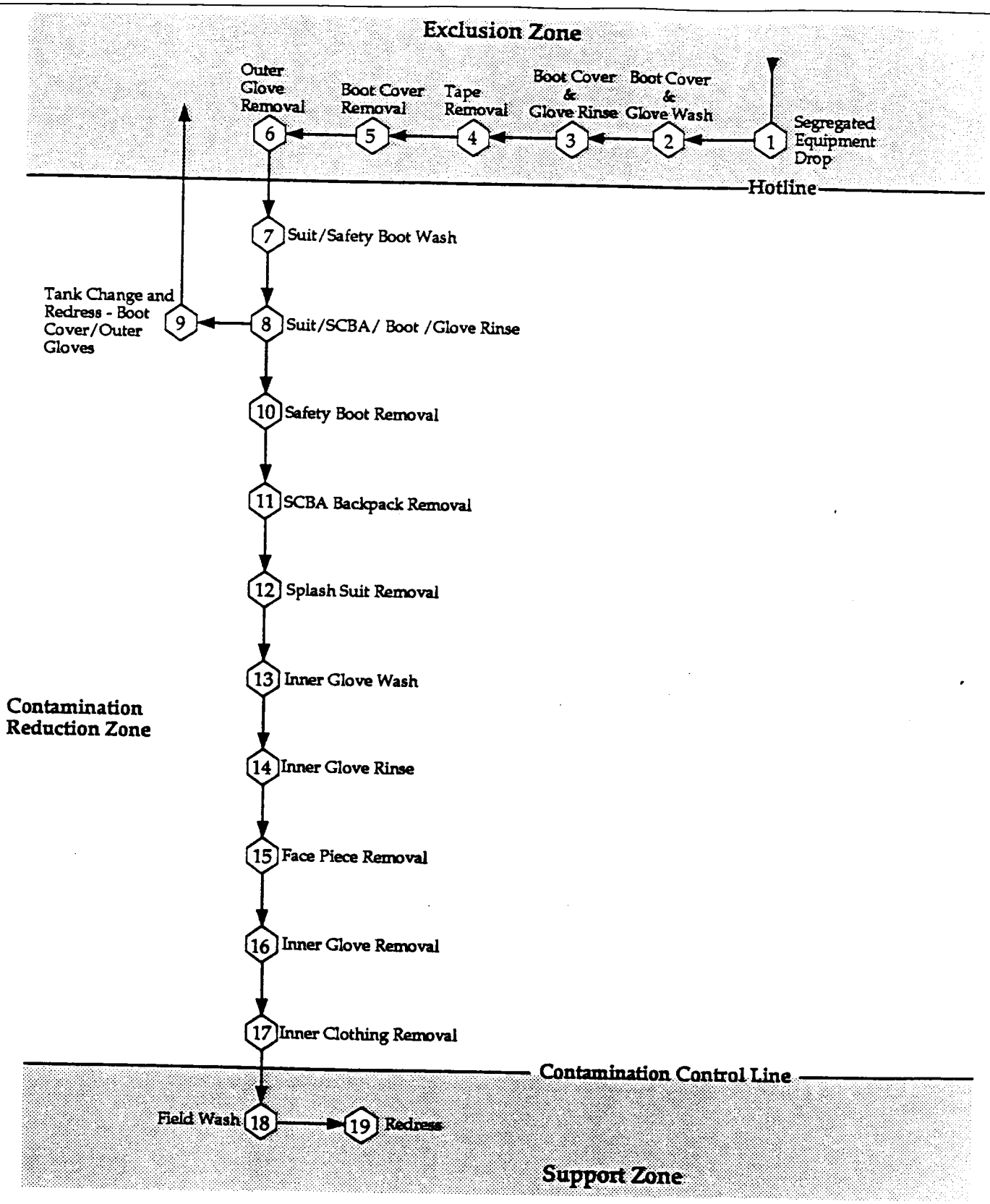


FIGURE L-3
MAXIMUM DECONTAMINATION LAYOUT
LEVEL B PROTECTION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

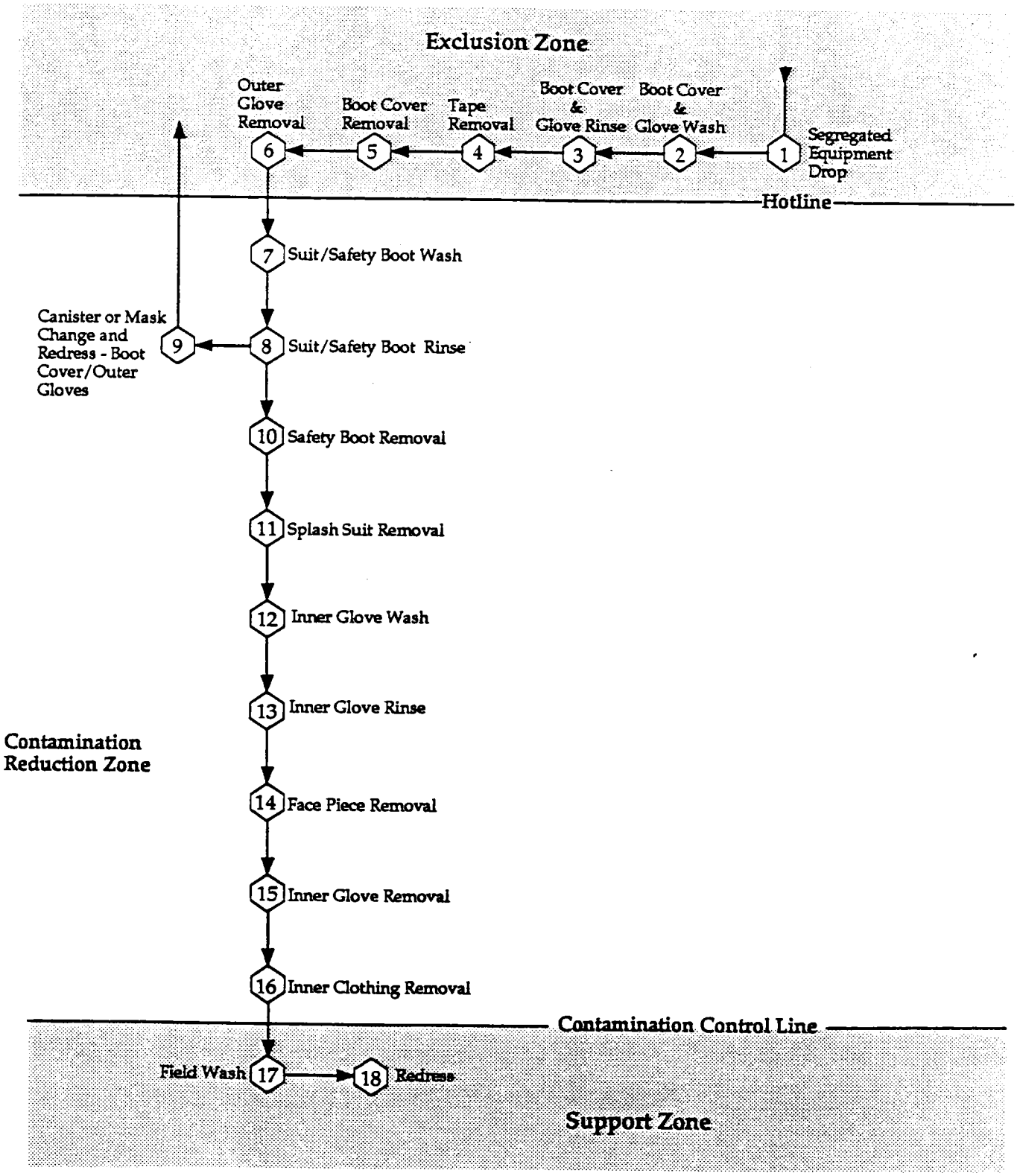


FIGURE L-4
MAXIMUM DECONTAMINATION LAYOUT
LEVEL C PROTECTION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

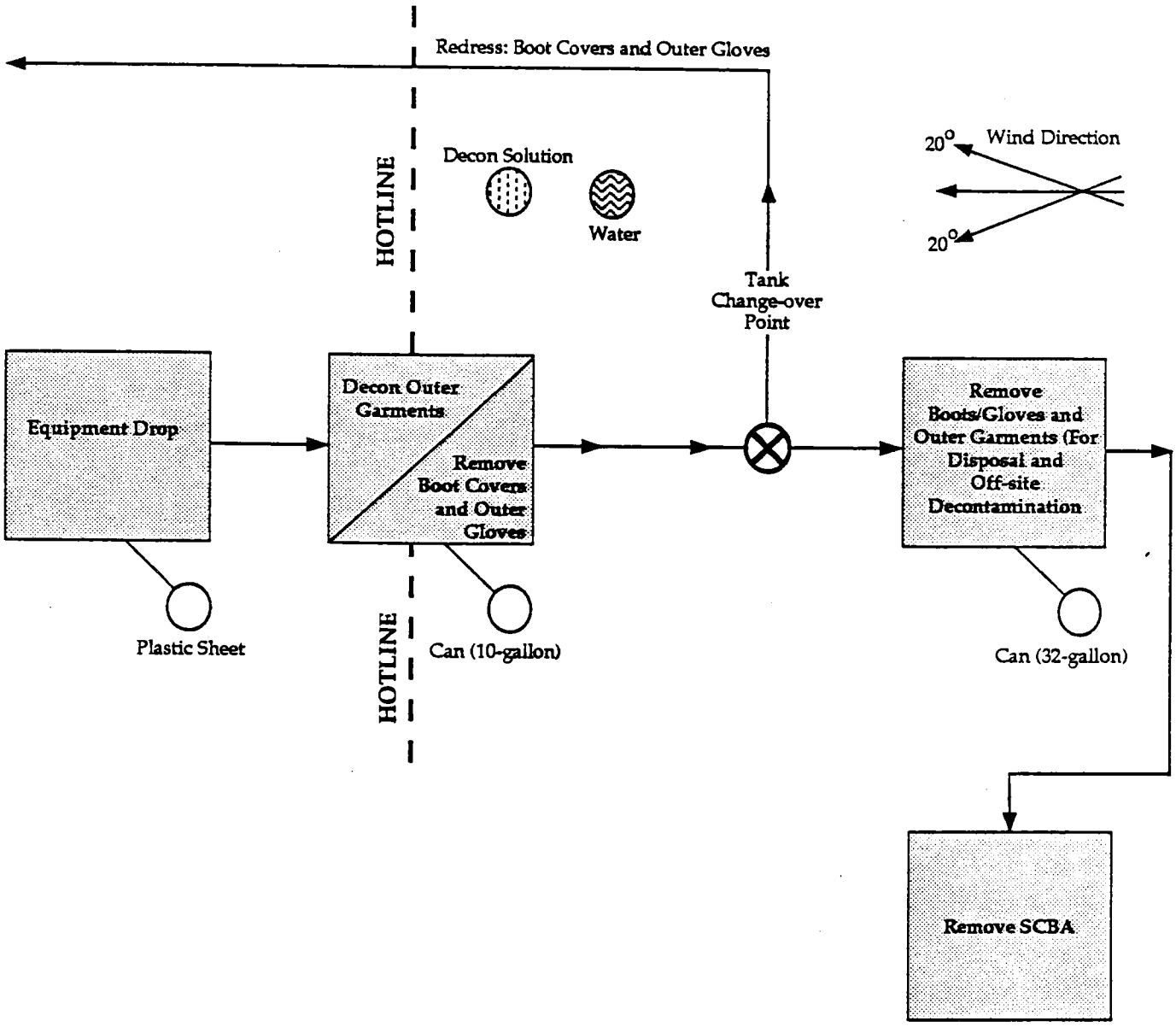


FIGURE L-5
MINIMUM DECONTAMINATION LAYOUT
LEVELS A & B PROTECTION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

8519-23

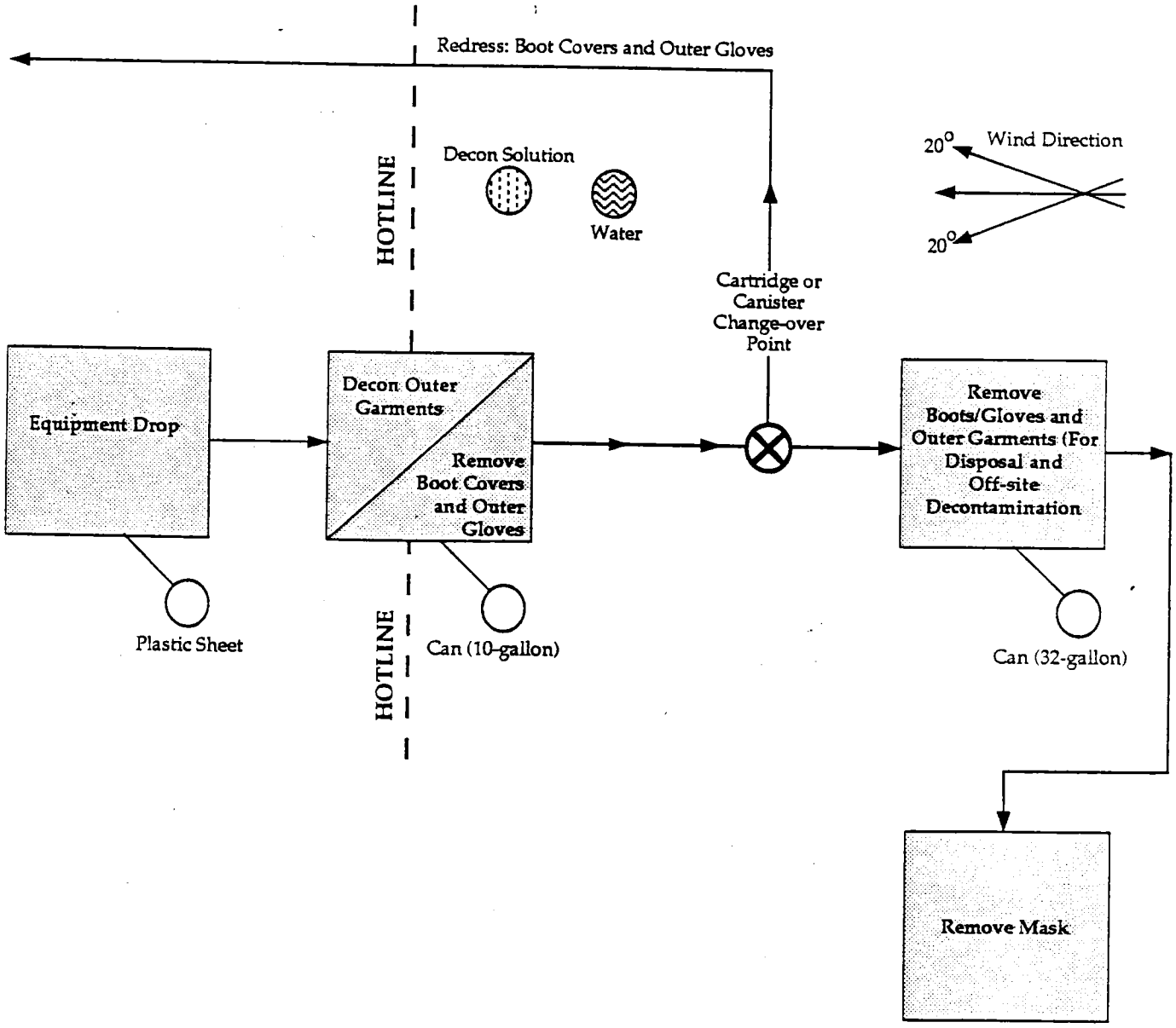


FIGURE L-6
MINIMUM DECONTAMINATION LAYOUT
LEVEL C PROTECTION

GENERIC HEALTH AND SAFETY PLAN

COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION, NAVY

Pressurized sprayers or other designated equipment will be available in the decontamination area for washdown and cleaning of personnel, samples, and equipment.

Respirators will be decontaminated daily and taken from the drop area. The masks will be disassembled, the cartridges set aside, and all other parts placed in a cleansing solution. Parts will be pre-coded (e.g., #1 on all parts of Mask #1). After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be marked to indicate length of use (i.e., if it is possible to evaluate the remaining utility of the cartridge), or discarded in the contaminated trash container for disposal. In the morning, the masks will be reassembled and new cartridges installed, if appropriate. Personnel will inspect their own masks and readjust the straps for proper fit.

L.2 SMALL EQUIPMENT DECONTAMINATION

Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible), without hindering operation of the unit. For example, the PI meter can be placed in a clear plastic bag to allow for reading the scale and operating the knobs. The PI meter can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings will be removed and disposed of in appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation, and then prepared with new protective coverings.

L.3 HEAVY EQUIPMENT DECONTAMINATION

It is anticipated that drilling rigs and backhoes will become contaminated during borehole and test-pitting activities. They will be cleaned with high-pressure water or steam, followed by a soap and water wash and rinse. Loose material will be removed with a brush. The person performing this activity will usually be at least at the level of protection used during the personnel and monitoring equipment decontamination.

L.4 DISPOSAL OF DECONTAMINATED MATERIALS

All protective gear, decontamination fluids (for both personnel and equipment), and other disposable materials will be disposed of at each site.

Decontamination fluids identified to be contaminated by site contaminants (i.e., Liqui-nox, used to decontaminate sampling equipment such as split spoons and groundwater sampling pumps) will be stored in DOT-approved 55-gallon drums. Contaminated disposable materials (e.g., gloves and Tyveks) will be double-bagged and stored as is, or placed in DOT-approved 55-gallon drums.

APPENDIX M EMERGENCY PLANNING

APPENDIX M EMERGENCY PLANNING

M.1 EMERGENCY MEDICAL SERVICES

Prior to site investigation or activity on hazardous sites, nearby health facilities will be evaluated to determine their ability to provide for the needs of on-site project staff. Criteria such as emergency department physician coverage, decontamination capabilities, and available medical specialists will be evaluated.

M.1.1 On-site First Aid

An industrial first-aid kit will be provided at the work site; contents of the kit will be checked weekly and restocked as necessary. Other equipment may include oxygen, backboard and straps, splints, and a cervical collar.

At least one person qualified to perform first aid will be present on-site at all times during work activity. This person will have earned a certificate in first-aid training from the American Red Cross or will have received equivalent training. Designated first aides will receive regular review training from the American Red Cross or the equivalent.

An eye-wash station will be provided at the work site, as well as flushing water for decontamination of boots, gloves, clothing, and tools.

M.1.2 Transportation to Emergency Treatment

A vehicle will be available at all times to transport personnel to the hospital (in the event an ambulance is unnecessary or unavailable). Stretchers will be located at the work site to transport personnel to the vehicle. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

M.2 CONTINGENCY PLANNING

Prior to commencement of on-site activities, the HSO will review safety considerations with the field crew. The HSO has overall responsibility for adherence to the designated safety precautions and assumes the role of on-site coordinator in an emergency response situation.

All on-site personnel will be familiarized with both the primary and secondary route to the nearest hospital (which may be shown on a figure or a local map), as well as the location of the nearest working telephone or radio communication device. A list of emergency telephone numbers will be posted in the trailer.

The local hospital and emergency response team will be advised in advance of the work to be performed. The hospital will also be briefed on the availability of personnel health data and technical support through Environmental Medicine Resources, Inc.

Emergency communication will be required to ensure positive preplanned notification of emergency authorities in the event of episodes requiring initiation of

contingency plans. Emergency communication will include all or parts of the following:

- Coordinate with local agencies, fire and police departments, the ambulance service, and the hospital emergency room.
- Establish two-way radio communication and a site alarm capable of warning site personnel and summoning assistance (i.e., airhorn).
- Design an emergency evacuation plan for residents of nearby homes. Although evacuation is an unlikely event, as a contingency, the HSO will be designated as on-site coordinator and will be responsible for implementing the plan. The HSO will be made aware of the total number of households within a 2,000-foot radius. The Health and Safety Plan will provide the emergency contacts required and a table will provide a list of residences and identifiable operations in the area in the event that evacuation is deemed a possibility for a particular site.
- Investigate possible routes of evacuation prior to any activity.
- If an accident occurs, a copy of an accident report form, provided in Appendix N, should be filled out by the HSO and filed with the individual's supervisor, the HSM or HSS, and Human Resources. A copy should also be retained in the project records.

M.3 POTENTIAL HAZARDS

The most common hazards associated with hazardous waste site investigation include (1) accidents; (2) inhalation, contact, or ingestion of hazardous materials; (3) explosion; and (4) fire.

M.3.1 Accidents

Accidents must be handled on a case-by-case basis. Minor cuts, bruises, muscle pulls, and the like will still allow the injured person to undergo reasonably normal decontamination procedures before receiving direct first aid. More serious injuries may not permit complete decontamination procedures to be undertaken, particularly if the nature of the injury is such that the victim should not be moved. In these cases, arrangements will be made with the medical facility and transporter to allow them to take proper precautions. The nature and degree of surface contamination at a site is generally low enough that emergency vehicles could reach the victim on-site without undue hazard. However, if on-site access is limited, accident victims may be transported by ABB-ES personnel trained for this response to a point accessible by an ambulance.

M.3.2 Contact and/or Ingestion of Hazardous Materials

Properly prescribed and maintained protective clothing and adherence to established safety procedures are designed to minimize this hazard. However, it is still possible that contact or ingestion of materials may occur. For example, puncture of a buried drum of liquid during drilling operations might cause the drum contents to contact personnel. Standard first-aid procedures should be

followed. The drilling rig will have a tank of water that may be useful in some circumstances, particularly to flush contaminants from any exposed skin areas. Eye-wash bottles will also be maintained at the site for emergencies. In cases of ingestion or anything other than minor contact with known substances, the local Poison Control Center and hospital should be notified and the victim taken there immediately for further treatment and observation.

M.3.3 Explosion

The drilling crew should be keenly aware of combustible gas meter readings and should withdraw at any indication of imminently hazardous conditions (i.e., greater than 20 percent LEL). The detection of such conditions will be reported to local agencies for potential execution of the evacuation plan, if the situation is assessed to warrant such response.

M.3.4 Fire

The combustible gas meter also warns of imminent fire hazards at borings. The greatest fire hazard at the site should be recognized as handling the fluids (e.g., methanol and acetone) used for certain decontamination procedures. No smoking or open flames are allowed on-site. Carbon dioxide fire extinguishers will be kept at the drilling rig and in the decontamination area/field office. The fire department, previously informed of site activities, will be called as needed.

M.4 EVACUATION RESPONSE LEVELS

Evacuation responses will occur at three levels: (1) withdrawal from immediate work area (100 feet or more upwind), (2) site evacuation, and (3) evacuation of surrounding area. Anticipated conditions that require these responses are described in the following subsections.

M.4.1 Withdrawal Upwind (100 Feet or More)

Withdrawing upwind (100 feet or more) will be required when (1) ambient air conditions contain greater contaminant concentrations than guidelines allow for the type of respiratory protection being worn (the work crew may return after donning greater respiratory protection and/or assessing the situation as transient and past); (2) a breach in protective clothing or minor accident occurs (the work crew may return when the tear or other malfunction is repaired and first aid or decontamination has been administered); or (3) the respirator malfunctions requiring replacement.

M.4.2 Site Evacuation

Evacuation of the site will be required when (1) ambient air conditions contain explosive and persistent levels of combustible gas or excessive levels of toxic gases; (2) a fire or major accident occurs; or (3) explosion is imminent or has occurred.

M.4.3 Surrounding Area Evacuation

The area surrounding the site will be evacuated when persistent, unsuppressable toxic or explosive vapors from test pits or borings (e.g., pressure release from punctured drum) are released, or air quality monitored at several points downwind assess danger to the surrounding area.

M.5 EVACUATION PROCEDURES

M.5.1 Withdrawal Upwind

The work crew will continually observe general wind directions while on-site. (A simple wind sock may be set up near the work site for visual determinations.) Upon observing conditions that warrant moving away from the work site, the crew will relocate upwind a distance of approximately 100 feet or farther, as indicated by the site monitoring instruments. Donning SCBA and a safety harness and line, the HSO and a member of the crew may return to the work site to determine whether the conditions noted were transient or persistent. If persistent, an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don SCBA. An attempt should be made to decrease emissions only if greater respiratory protection is donned. The HSM, HSS, and client will be notified of conditions. When access to the site is restricted and escape is thereby hindered, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

M.5.2 Site Evacuation

After determining that site evacuation is warranted, the work crew will proceed upwind of the work site and notify the security force, HSO, and field office of site conditions. If the decontamination area is upwind and more than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation, where the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, they will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and implemented by the HSO.

M.5.3 Evacuation of Surrounding Area

When the HSO determines that conditions warrant evacuation of downwind residences and commercial operations, the local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

APPENDIX N HEALTH AND SAFETY FORMS AND DATA SHEETS

APPENDIX N HEALTH AND SAFETY FORMS AND DATA SHEETS

N.1 HEALTH AND SAFETY AUDIT

Site Name: _____ Date: _____

Auditor: _____

SEND A COPY OF COMPLETED FORM TO THE HEALTH AND SAFETY MANAGER.

GENERAL	YES	NO	COMMENTS
HASP on-site?	___	___	_____
HASP completely signed off and approved?	___	___	_____
OSHA poster posted in trailer?	___	___	_____
Emergency telephone numbers posted in trailer?	___	___	_____
Emergency eyewash on-site?	___	___	_____
Emergency shower on-site?	___	___	_____
Stretcher on-site?	___	___	_____
First-aid kit on-site?	___	___	_____
Adequately stocked?	___	___	_____
Proper sanitation facilities?	___	___	_____
DOCUMENTATION AND RECORDKEEPING			
Only personnel listed and approved in HASP on-site?	___	___	_____
All personnel properly trained?	___	___	_____
All personnel in health monitoring program?	___	___	_____
Daily field records kept by the Site Manager?	___	___	_____
Levels of PPE recorded?	___	___	_____
Contaminant levels recorded?	___	___	_____
Site surveillance records kept by HSO?	___	___	_____

	YES	NO	COMMENTS
Calibration records maintained?	___	___	_____
Accident/incident forms on-site?	___	___	_____
Field team review sheets signed?	___	___	_____
Medical data sheets completed?	___	___	_____
Spare hospital directions available?	___	___	_____
Visitors logbook completed?	___	___	_____
MSDSs for chemicals on-site?	___	___	_____
HASP revisions recorded?	___	___	_____
First-aid kit inspected weekly?	___	___	_____
Are daily safety meetings held?	___	___	_____
Emergency procedures discussed during safety meetings?	___	___	_____

EMERGENCY RESPONSES

	YES	NO	COMMENTS
Vehicle available on-site for transportation to the hospital?	___	___	_____
Fire extinguishers on-site?	___	___	_____
At least two persons trained in CPR and first-aid on-site at all times?	___	___	_____
All personnel know who is trained?	___	___	_____

PERSONNEL PROTECTIVE EQUIPMENT

Proper PPE being worn as specified in the HASP?	___	___	_____
Level of PPE being worn:			_____
PPE adequate for work conditions?	___	___	_____
If not, give reason:			_____
Upgrade/downgrade to PPE level:			_____
Has facial hair that would interfere with fit of respirators been removed?	___	___	_____

	YES	NO	COMMENTS
If not, willing to shave if necessary?	___	___	_____
Fit-tested within the last year?	___	___	_____
If Level B, back-up/emergency person suited up (except for air)?	___	___	_____
HSO periodically inspects PPE and equipment?	___	___	_____
PPE not in use properly stored?	___	___	_____
MONITORING EQUIPMENT			
All equipment listed in HASP on-site?	___	___	_____
Properly calibrated?	___	___	_____
In good condition?	___	___	_____
Used properly?	___	___	_____
Other equipment needed?	___	___	_____
List:	_____		
Monitoring equipment covered with plastic to minimize contamination?	___	___	_____
DECONTAMINATION			
Decon line set up properly?	___	___	_____
Proper cleaning fluid used for known or suspected contaminants?	___	___	_____
Proper decon procedures used?	___	___	_____
Decon personnel wearing proper PPE?	___	___	_____
Equipment decontaminated?	___	___	_____
Samples decontaminated?	___	___	_____
Disposable items changed twice a day or more often if needed?	___	___	_____

WORK PRACTICES	YES	NO	COMMENTS
Proper collection and disposal of contaminated PPE?	___	___	_____
Proper collection and disposal of decon fluid?	___	___	_____
Water available for decon?	___	___	_____
Buddy system used?	___	___	_____
Equipment kept off drums and ground?	___	___	_____
Kneeling or sitting on drums or ground not allowed?	___	___	_____
Personnel avoid standing or walking through puddles or stained soil?	___	___	_____
Zones established?	___	___	_____
If night work to be conducted, adequate illumination?	___	___	_____
Smoking, eating, or drinking in the Exclusion Zone or CRZ not allowed?	___	___	_____
To the extent feasible, contaminated materials handled remotely?	___	___	_____
Contact lenses not allowed on-site?	___	___	_____
Entry into excavations not allowed unless properly shored or sloped?	___	___	_____
All unusual situations on-site listed in HASP?	___	___	_____
If not, what?	_____		
Action taken?	_____		
HASP revised?	___	___	_____
CONFINED SPACE ENTRY			
All confined spaces identified?	___	___	_____
If not, list:	_____		
All appropriate equipment available and in good working order?	___	___	_____

	YES	NO	COMMENTS
Equipment properly calibrated?	____	____	_____
Confined Space Checklists used?	____	____	_____
Checklists completely and correctly filled out?	____	____	_____

ABB ENVIRONMENTAL SERVICES INC.
ACCIDENT REPORT

SITE INFORMATION:

.ce:_____ Job Number:_____
Location:_____
Location of Accident (if different from above):_____
Did injury involve ABB–ES employee?:_____ Subcontractor?:_____ Other?:_____

PERSONAL INFORMATION:

Name of Injured Person:_____
Address of Injured Person:_____
SSN:_____ DOB:_____ Marital Status:_____
Department:_____ Date of Hire:_____

ACCIDENT INFORMATION:

Date of Accident:_____ Time of Accident:_____ Weather Conditions:_____
Name of Witness:_____ Telephone No.:_____
Address:_____

Accident Category:
☐ Chemical Exposure ☐ Physical Injury ☐ Motor Vehicle ☐ Fire
☐ Property Damage (list):_____ ☐ Other:_____

Severity:
☐ Medical Treatment ☐ Non–disabling ☐ Disabling ☐ Fatality
☐ Estimated Amount of Property Damage:_____

Classification of Injury:

☐ Heat Burns	☐ Allergic Reaction	☐ Lacerations	☐ Fracture
☐ Chemical Burns	☐ Bites	☐ Punctures	☐ Dislocations
☐ Radiation Burns	☐ Poison Ivy	☐ Abrasions	☐ Nausea
☐ Toxic–Respiratory	☐ Heat Stroke	☐ Sprains	☐ Headache
☐ Toxic–Dermal	☐ Cold Exposure	☐ Bruises	☐ Faint/Dizzy
☐ Toxic–Ingestion	☐ Blisters	☐ Concussion	

☐ Other:_____

If chemical exposure, list all possible contaminants of concern:_____

Part(s) of Body Affected:_____ Degree of Disability:_____
Date Medical Care Received:_____ Emergency Service:_____ Follow–up Examination Needed:_____
Name and Address of Medical Facility:_____

Name of Attending Physician:_____ Telephone Number:_____
te/Time Employee went back to work:_____ Employee on Restricted Duty?_____
stimated Number of Days Away From Work:_____

CAUSE OF INJURY/ACCIDENT:

Causitive agent(s) most directly related to accident (e.g., object, substance, material, machinery, equipment, or weather):_____

Were there unsafe mechanical/physical/environmental condition(s) at the time of the accident?:_____

Did an unsafe act contribute to the accident? If yes, specify:_____

Did personal factors contribute to the accident (e.g., improper attitude, lack of knowledge or skill, slow reaction, fatigue, inattention, or horseplay.):_____

ACCIDENT PREVENTION:

Level of Personal Protective Equipment required in the HASP:_____
Was injured using required equipment?:_____. If not, how did actual equipment differ from what was required in the HASP. Describe:_____

Was personal protective equipment required in the HASP adequate for site conditions?_____
If no, what additional equipment was needed?:_____

What can be done to prevent a re-occurrence of this type of accident? (e.g., ventilation, machine modification/ guarding, modification of work practices, or additional training.):_____

NARRATIVE:

Provide a detailed description of how and why the accident occured. Include objects, equipment, tools, circumstances of assigned duties, weather, etc. Be specific.:_____

Signature of Preparer:_____Date:_____
Signature of Site Manager:_____Date:_____

SEND A COPY OF THE COMPLETED FORM TO THE MANAGER, HEALTH AND SAFETY - PORTLAND, ME.

N.3 HSO CHECKLIST FOR FIELD OPERATIONS

The following is a list of the minimum equipment and materials needed to fulfill the requirements for health and safety at a site. This list does not include monitoring equipment, decontamination equipment, or personal health and safety equipment (e.g., respirators, tyveks, and boots).

Need	Posted?	Paperwork
☐		Health and Safety Plan
☐		Health and Safety Plan Appendix
☐		Field Team Review Sheets
☐		Medical Data Sheets
☐	☐	OSHA Job Safety & Health Protection Poster
☐	☐	Emergency Information Sheet
☐	☐	Spare Hospital Directions
☐		Blank Accident Report Forms
☐		Visitors Logbook
☐		H & S Audit Form
☐		Confined Space Entry Forms
☐		Site-specific HASP Attachments
☐		MSDSs for Chemicals Taken On-site (other than those in HASP Appendix)
☐		1.
☐		2.

Need	Quantity	Equipment
☐	☐	First Aid Kit
☐	☐	Emergency Eye Wash Station
☐	☐	Fire Extinguisher
☐	☐	Emergency Horn
☐	☐	Emergency Stretcher/Backboard

FROM: ALCONOX, Inc.

Quality Detergents for Laboratory, Hospital, Industry
215 PARK AVENUE SOUTH NEW YORK, N.Y. 10003

TO: CE Environmental

ATTN Bill Thurston

FAX: 207-773-0011

DATE: 11/19/90

PAGE 1 OF 6

FROM: Malcolm

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List)

LIQUI-NOX

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name
ALCONOX, INC.

Address (Number, Street, City, State, and ZIP Code)
215 PARK AVENUE SOUTH
NEW YORK, NEW YORK 10003

Emergency Telephone Number
(212) 473-1108

Telephone Number for Information
(212) 473-1100

Date Prepared
JULY 1, 1987

Signature of Preparer (optional)

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)

THERE ARE NO INGREDIENTS IN LIQUI-NOX WHICH APPEARED ON THE OSHA STANDARD 29 CFR 1910 SUBPART Z.

Section III — Physical/Chemical Characteristics

Boiling Point	214°F	Specific Gravity (H2O = 1)	1.075
Vapor Pressure (mm Hg.)	NO DATA	Melting Point	N.A.
Vapor Density (Air = 1)	NO DATA	Evaporation Rate (Butyl Acetate = 1)	NO DATA

Solubility in Water
COMPLETELY SOLUBLE IN ALL PROPORTIONS

Appearance and Odor
YELLOW LIQUID - PRACTICALLY ODORLESS

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)
NONE (CLEVELAND OPEN CUP)

Flammable Limits: LEL N.A. UEL N.A.

Extinguishing Media
WATER, DRY CHEMICAL, FOAM, CO_2, SAND/EARTH

Special Fire Fighting Procedures
FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER WITHOUT PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS.

Unusual Fire and Explosion Hazards
NONE

Section V — Reactivity Data

Stability: Unstable / Stable (XX) — Conditions to Avoid: NONE

Incompatibility (Materials to Avoid)
NONE

Hazardous Decomposition or Byproducts
SO_2 MAY BE RELEASED ON BURNING

Hazardous Polymerization: May Occur / Will Not Occur (XX) — Conditions to Avoid: NONE

Section VI — Health Hazard Data

Routes of Entry: Inhalation? NO — Skin? YES — Ingestion? YES

Health Hazards (Acute and Chronic)
SKIN CONTACT MAY PROVE LOCALLY IRRITATING.
INGESTION MAY CAUSE DISCOMFORT AND/OR DIARRHEA.

Carcinogenicity: NTP? NO — IARC Monographs? NO — OSHA Regulated? NO

Signs and Symptoms of Exposure
PROLONGED SKIN CONTACT MAY CAUSE DRYING AND/OR CHAPPING.

Medical Conditions Generally Aggravated by Exposure: NONE

Emergency and First Aid Procedures
EYES-FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SKIN-FLUSH WITH WATER.
INGESTION-DRINK LARGE QUANTITIES OF WATER. GET MEDICAL ATTENTION FOR DISCOMFORT

Section VII — Precautions for Safe Handling and Use

Steps To Be Taken In Case Material Is Released or Spilled
MATERIAL FOAMS PROFUSELY. RECOVER AS MUCH AS POSSIBLE WITH ABSORBENT MATERIAL AND RINSE REMAINDER TO SEWER. MATERIAL IS COMPLETELY BIODEGRADABLE.

Waste Disposal Method
SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD BE SOAKED UP WITH ABSORBENT MATERIAL AND DISPOSED OF ACCORDING TO LOCAL ORDINANCE.

Precautions to Be Taken in Handling and Storing
NONE REQUIRED -VISCOSITY OF MATERIAL INCREASES AT VERY LOW TEMPERATURES.

Other Precautions
NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL

Section VIII — Control Measures

Respiratory Protection (Specify Type)

Ventilation: Local Exhaust NORMAL — Special: N.A. — Mechanical (General): N.A. — Other: N.A.

Protective Gloves: RECOMMENDED — Eye Protection: RECOMMENDED

Other Protective Clothing or Equipment
NOT REQUIRED

Work Hygienic Practices
NO SPECIAL PRACTICES REQUIRED

N.4.1 LIQUI-NOX

Monsanto MATERIAL SAFETY DATA

NER CODE A-111

MONSANTO PRODUCT NAME

TRISODIUM PHOSPHATE CRYSTALLINE

MONSANTO COMPANY
800 N. LINDBERGH BLVD.
ST. LOUIS, MO 63167

Emergency Phone No.
(Call Collect)
314-694-1000

PRODUCT IDENTIFICATION

Synonyms:	TSP/C; Trisodium orthophosphate; Sodium phosphate, tribasic; Phosphoric acid, trisodium salt; Trisodium phosphate dodecahydrate
Chemical Formula:	$Na_3PO_4 \cdot 12H_2O \cdot 1/4\ NaOH$ (approximately)
CAS No.:	10101-89-0*
DOT Proper Shipping Name:	Sodium Phosphate, Tribasic (see NOTE below)
DOT Hazard Class/ I.D. No.:	ORM-E/NA9148
DOT Label(s):	Not Applicable
Hazardous Substance(s)/ RQ(s):	Yes/5,000 lbs.
U.S. Surface Freight Classification:	Trisodium Phosphate

Note: Bagged material is not regulated.

*Since hydrated materials could not be reported on the TSCA Initial Inventory List, Trisodium Phosphate Crystalline was reported as anhydrous with the CAS No. 7601-54-9.

WARNING STATEMENTS

DANGER!
CAUSES EYE BURNS
CAUSES SKIN IRRITATION

PRECAUTIONARY MEASURES

Do not get in eyes, on skin, on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY AND FIRST AID PROCEDURES

FIRST AID: IF IN EYES, immediately flush with plenty of water for at least 15 minutes. Call a physician.

IF ON SKIN, immediately flush with plenty of water. Remove contaminated clothing. Wash clothing before reuse.

MATERIAL SAFETY DATA TRISODIUM PHOSPHATE CRYSTALLINE

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

EMPLOYERS

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm or employees. Employers must comply with occupational safety and health standards issued under the Act.

EMPLOYEES

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

INSPECTION

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

COMPLAINT

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides the employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

CITATION

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

PROPOSED PENALTY

The Act provides for mandatory civil penalties against employers of up to $7,000 for each serious violation and for optional penalties of up to $7,000 for each nonserious violation. Penalties of up to $7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $70,000 for each such violation. A violation of posting requirements can bring a penalty of up to $7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to $250,000 (or $500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of $10,000 or up to six months in jail or both.

VOLUNTARY ACTIVITY

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for health such as training.

VOLUNTARY ACTIVITY

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State labor or Health department or a State university.

POSTING INSTRUCTIONS

Employees in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia	(404) 347-3573	Washington, D.C.
Boston, Massachusetts	(617) 565-7164	1991 (Reprinted)
Chicago, Illinois	(312) 353-2220	OSHA 2203
Dallas, Texas	(214) 767-4731	
Denver, Colorado	(303) 844-3061	
Kansas City, Missouri	(816) 426-5861	
New York, New York	(212) 337-2378	Lynn Martin, Secretary of Labor
Philadelphia, Pennsylvania	(215) 596-1201	**U.S. Department of Labor**
San Francisco, California	(415) 744-6670	Occupational Safety and Health Administration
Seattle, Washington	(206) 442-5930	

To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

N.6 DAILY HEALTH AND SAFETY AUDIT

Site Name: _____ Date: _____

Auditor: _____

SEND A COPY OF COMPLETED FORM TO THE HEALTH AND SAFETY MANAGER

	YES	NO	N/A	COMMENTS (Use back of form if more space is needed)
1. Safety meeting held today?				
2. Emergency procedures discussed during safety meeting?				
3. Vehicle available on-site for transportation to the hospital?				
4. At least two persons trained in CPR and first-aid on-site?				
5. Proper PPE being worn as specified in the HASP?				
Level of PPE being worn: _____				
6. PPE adequate for work conditions?				
If not, give reason: _____				
Upgrade/downgrade to PPE level: _____				
7. If Level B, back-up/emergency person suited up (except for air)?				
8. Monitoring equipment calibrated?				
9. Monitoring equipment in good condition?				
10. Monitoring equipment used properly?				
11. Other monitoring equipment needed?				
List: _____				
12. Monitoring equipment covered with plastic to minimize contamination?				
13. Decon line set up properly?				
14. Proper cleaning fluid used for known or suspected contaminants?				
15. Proper decon procedures used?				
16. Decon personnel wearing proper PPE?				
17. Equipment decontaminated?				
18. Samples decontaminated?				
19. Disposable items changed twice a day or more often if needed?				
20. Proper collection and disposal of contaminated PPE?				
21. Proper collection and disposal of decon fluid?				
22. Buddy system used?				
23. Equipment kept off drums and ground?				
24. Kneeling or sitting on drums or ground not allowed?				
25. Personnel avoid standing or walking through puddles or stained soil?				
26. Zones established?				
27. If night work to be conducted, adequate illumination?				
28. Smoking, eating, or drinking in the Exclusion Zone or CRZ not allowed?				
29. To the extent feasible, contaminated materials handled remotely?				
30. Entry into excavations not allowed unless properly shored or sloped?				
31. All unusual situations on-site listed in HASP?				
If not, what? _____				
Action taken? _____				
HASP revised? _____				
32. All confined spaces identified?				
If not, list: _____				
33. Confined Space Checklists used?				
34. Confined Space Checklists completely and correctly filled out?				

ALL DEFICIENCIES MUST BE CORRECTED IMMEDIATELY!

APPENDIX O RESPIRATORY PROTECTION PROGRAM

APPENDIX O RESPIRATORY PROTECTION PROGRAM

O.1 INTRODUCTION

This program was developed to govern the selection and use of respiratory protective devices by ABB-ES personnel. The program is intended to comply with OSHA requirements as set forth in 29 CFR 1910.134(b). The scope of this program is limited to activities related to field investigations of potentially hazardous waste disposal sites.

O.2 PERSONNEL REQUIREMENTS

All personnel assigned to field activities at hazardous or potentially hazardous locations are currently required by ABB-ES's health and safety policies to be enrolled in the corporate health monitoring program. Part of this program involves spirometry, a measure of the respiratory system status. No personnel may be assigned to the use of or may withdraw from stock any respiratory protective device without a physician's certification that use of the device will not be injurious to health. Psychological limitations (e.g., claustrophobia) are also considered in personnel assignments. Training in the use of the selected device and fit testing, as described herein, are also required.

Personnel will not be assigned duties that require a respirator when facial hair, skullcaps, or eyeglasses will interfere with a proper fit. Contact lenses may not be worn with any respiratory protective device. Eyeglass frames that fit inside the respirator facepiece are provided as necessary.

O.3 APPLICABLE EQUIPMENT

ABB-ES maintains the following respiratory protective equipment:

- full-face chemical/mechanical air-purifying respirators
- SCBA
- full-face airline-supplied breathing apparatus
- 5-minute escape air supply

This equipment is intended for use on an as-needed basis, to be determined by an evaluation of on-site conditions. Respiratory protective equipment should not be used arbitrarily by any ABB-ES personnel. Selection criteria are presented separately; training is required in the use of <u>each</u> type of equipment before drawing from stock.

O.4 PERSONNEL TRAINING

Training of personnel in the proper use and care of respiratory protective equipment is considered essential to the success of the program. Training encompasses the following topics:

- respiratory protection principles
- selection of appropriate equipment
- use of equipment
- maintenance of equipment
- fit testing

Information regarding each topic is presented as standard respiratory protection procedures in the corporate health and safety program manual.

0.5 PROGRAM ADMINISTRATION AND DOCUMENTATION

Administration of the ABB-ES Respiratory Protection Program is the responsibility of the HSM, and includes the following:

- respirator selection
- personnel training
- fit testing
- respirator maintenance
- documentation
- program evaluation and improvements
- personnel pulmonary testing and certification

Fit testing and respirator maintenance is performed by the equipment manager of ABB-ES's Sample Control and Staging Center in Portland, Maine, and designated, trained employees at the other offices. All fit-testing and respirator maintenance is conducted under the administration of the HSM. Major maintenance is performed by manufacturer-certified technicians only. Personnel training in respiratory protection is one aspect of the HSM's ongoing personnel training programs. Program evaluation is a dynamic process, occurring each time a project HASP is prepared.

Medical supervision of personnel occurs as part of the ABB-ES health monitoring program, also administered by the HSM. Medical surveillance is required for all personnel assigned to hazardous or potentially hazardous site activities.

Documentation of the various elements of the ABB-ES respiratory protection program is achieved through several media, as follows:

- Documentation of respirator selection is included in the hazard assessment of each site's HASP.
- Documentation of personnel training is maintained in both hardcopy and computerized files.

- Documentation of medical surveillance is achieved indirectly by maintaining a list of enrolled employees in the health monitoring program, and directly through physician certification of personnel allowed to be assigned respiratory protective devices.

- Using the appropriate form, documentation of fit-testing is maintained on file with the equipment manager of the Sample Control and Staging Center and with the HSM or designee.

- Documentation of site surveillance is required both by this program and by the HASP for each site. Records of site surveillance are created by the HSO and maintained in project files.

- Respirator inspection and maintenance records are created and maintained by the equipment manager for each respirator, SCBA, and escape respirator.

Inspection and documentation occurs either before each unit is removed from stock and when it is returned, or monthly.

O.6 INSPECTION, MAINTENANCE, AND STORAGE

O.6.1 Introduction

Respirator maintenance is an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator, in one sense, is more dangerous than not wearing a respirator at all. Personnel wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance because they generally are used infrequently, and then in the most hazardous and demanding circumstances. Serious injury or death can result from wearing a defective device during an emergency escape or rescue. The respirator program includes the following components:

- inspection for defects (including a leak check)

- cleaning and disinfecting

- repair as required

- proper and sanitary storage of equipment

O.6.2 Inspection for Defects

The most important part of a respirator maintenance program is continual inspection of the devices. If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. Two types of inspections will be performed: (1) while the respirator is in use, and (2) while it is being cleaned. Because the use and cleaning will be performed primarily by the same personnel, these inspections may become concurrent.

0.6.3 Frequency of Inspection

OSHA requires that "All respirators be inspected before and after each use," and that those not used routinely (i.e., emergency escape and rescue devices) "shall be inspected after each use and at least monthly...." Obviously, emergency escape and rescue devices do not require inspection before each use.

0.6.4 Inspection Procedures

Respirator inspection will include checking of the following:

- tightness of the connections
- facepiece
- valves
- connecting tubes
- canisters, filters, or cartridges

In addition, the regulator and warning devices on a SCBA will be checked for proper functions.

0.6.5 Field Inspection of Air-purifying Respirators

Routinely used air-purifying respirators will be checked as follows before and after each use:

1. Examine the facepiece for:
   - excessive dirt
   - cracks, tears, holes, or physical distortion of shape from improper storage
   - inflexibility of rubber facepiece (stretch and knead to restore flexibility)
   - cracked or badly scratched lenses in full facepieces
   - incorrectly mounted full facepiece lenses, or broken or missing mounting clips
   - cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s)
2. Examine the head straps or head harness for:
   - breaks
   - loss of elasticity
   - broken or malfunctioning buckles and attachments
   - excessively worn serrations on head harness, which might permit slippage (full facepieces only)

3. Examine the exhalation valve for the following after removing the cover:

   - foreign material (e.g., detergent residue, dust particles, or human hair under valve seat)
   - cracks, tears, or distortion in the valve material
   - improper insertion of the valve body in the facepiece
   - cracks, breaks, or chips in the valve body, particularly the sealing surface
   - missing or defective valve cover
   - improper installation of the valve in the valve body

4. Examine the air-purifying element(s) for:

   - incorrect cartridge, canister, or filter for the hazard
   - incorrect installation, loose connections, missing or worn gasket, or cross-threading in the holder
   - expired shelf-life date on the cartridge or canister
   - cracks or dents in the outside case of the filter, cartridge, or canister indicated by the absence of sealing material, tape, or foil over the inlet
   - identical cartridges if more than one are used

0.6.6 Care and Cleaning of Self-contained Breathing Apparatus

The proper care of SCBAs involves the following:

- inspection for defects
- cleaning and disinfecting
- repair
- storage

The following checklist is to be used by personnel whenever they check out a SCBA. (Note: Any discrepancy found should be cause to set the unit aside until it can be repaired by a certified repairperson.)

1. Preliminary Inspection. Check to ensure that:

   - high-pressure hose connector is tight on cylinder fitting
   - bypass valve is closed

- mainline valve is closed
- there is no cover or obstruction on regulator outlet
- pressure in the tank is at least 1,800 psi

2. Backpack and Harness Assembly.

- Straps
  - visually inspect for complete set
  - visually inspect for frayed or damaged straps that may break during use
- Buckles
  - visually inspect for mating ends
  - check locking function
- Backplate and Cylinder Lock
  - visually inspect backplate for cracks and for missing rivets or screws
  - visually inspect cylinder hold-down strap and physically check strap tightener and lock to ensure that it is fully engaged

3. Cylinder and Cylinder Valve Assembly.

- Cylinder
  - physically check cylinder to ensure that it is tightly fastened to backplate
  - check hydrostatic test date to ensure that it is current
  - visually inspect cylinder for large dents or gouges in metal
- Head and Valve Assembly
  - visually inspect cylinder for presence of valve lock
  - visually inspect cylinder gauge for condition of face, needle, and lens
  - open cylinder valve and listen or feel for leakage around packing (if leakage is noted, do not use until repaired); note function of valve lock

4. Regulator and High-pressure Hose.

- High-pressure Hose and Connector. Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily mean a faulty hose.)

- Regulator and Low-pressure Alarm

  - Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1,800 psi and not more than rated cylinder pressure).
  - Close cylinder valve and slowly move hand from regulator outlet to allow slow flow of air. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 650 and 550 psi. Remove hand completely from outlet and close mainline valve.
  - Place mouth onto or over regulator outlet and blow. A positive pressure should be created and maintained for 5 to 10 seconds without any loss of air. Next, establish a slight negative pressure in regulator and hold for 5 to 10 seconds. Vacuum should remain constant. This tests the integrity of the diaphragm. Any loss of pressure or vacuum during this test indicates a leak in the apparatus.
  - Open cylinder valve.
  - Place hand over regulator outlet and open mainline valve. Remove hand from outlet and replace in rapid movement. Repeat twice. Air should escape when hand is removed each time, indicating a positive pressure in chamber. Close mainline valve and remove hand from outlet.
  - Ascertain that no obstruction is in or over the regulator outlet. Open and close the bypass valve momentarily to ensure flow of air through bypass system.

5. Facepiece and Corrugated Breathing Tube.

- Facepiece

  - Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.
  - Retaining clamp properly in place, visually inspect lens for proper seal in rubber facepiece, and for cracks or large scratches.
  - Visually inspect exhalation valve for visible deterioration or foreign materials buildup.

- Breathing Tube and Connector

  - Stretch breathing tube and visually inspect for deterioration and holes.
  - Visually inspect connector to ensure good condition of threads and for presence and proper condition of "O" ring or rubber gasket seal.
  - Perform a negative pressure test on facepiece.

    a. Don backpack and facepiece.

b. With facepiece held tightly to face or facepiece properly donned, stretch breathing tube to open corrugations and place thumb or hand over end of connector.

c. Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face. This negative pressure should be maintained for 5 to 10 seconds. If negative pressure leaks down, the facepiece assembly is not adequate and should not be worn.

6. Storage of Units. Check that:

- cylinder is refilled as necessary and unit is cleaned and inspected
- cylinder valve is closed
- high-pressure hose connector is tight on cylinder
- pressure is bled off high-pressure hose and regulator
- bypass valve is closed
- mainline valve is closed
- all straps are completely loosened and laid straight
- facepiece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals

O.6.7 Cleaning and Sanitizing

Any good detergent may be used, followed by a disinfecting rinse or a combination disinfectant-detergent for a one-step operation. Reliable, effective disinfectants can be made from readily available household solutions, including the following:

- Hypochlorite solution (50 ppm of chlorine) can be made by adding approximately 2 milliliters of bleach (e.g., Clorox) to 1 liter of water, or 2 tablespoons of bleach per gallon of water. A 2-minute immersion disinfects the respirators.
- Aqueous solution of iodine (50 ppm of iodine) can be made by adding approximately 0.8 milliliter of tincture of iodine per liter of water, or 1 teaspoon of tincture of iodine per gallon of water. A 2-minute immersion is sufficient to disinfect the respirators.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F; however, to ensure adequate cleaning, it should not be less than 120°F.

0.6.8 Rinsing

The cleaned and disinfected respirators should be rinsed thoroughly in water (140°F maximum) to remove all traces of detergent and disinfectant. This is important for preventing dermatitis.

0.6.9 Drying

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes; however, care must be taken not to damage or distort the facepieces.

0.6.10 Reassembly and Inspection

To avoid contamination, the clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area. The inspection procedures were discussed previously; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking. The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks. For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check should be performed.

0.6.11 Maintenance and Repair

Replacement or repair should be done only by trained, experienced persons using parts designed for the respirator. Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval of the device. This restriction applies particularly to maintenance of the more complicated devices, especially SCBA, and more specifically, regulator valves and low-pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair. No problems are anticipated in repairing and maintaining most simple respirators, particularly the commonly used air-purifying type.

0.6.12 Respirator Storage

Respirators must be stored properly to protect against the following:

- dust
- sunlight
- heat
- extreme cold
- excessive moisture
- damaging chemicals
- mechanical damage

Damage and contamination of respirators may occur if they are stored on a workbench; in a tool cabinet or toolbox among heavy tools, greases, and dirt; or in a vehicle.

APPENDIX P OTHER

APPENDIX P OTHER

P.1 ILLUMINATION

Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light, downrange operations must halt in time to permit personnel and equipment to exit the Exclusion Zone and proceed through decontamination before dusk. Conversely, operations will not be permitted to begin until lighting is adequate.

P.2 SANITATION

Provisions must be made for sanitation facilities for the site work force. At a minimum, the provision of toilet facilities must meet the requirements of 29 CFR 1910.120(n), which includes one facility for less than 20 employees, or one toilet and one urinal for every 40 employees, up to 200; then one of each for every 50 employees. If it is a mobile crew and they have transport readily available, the requirements do not apply.

P.3 HEALTH AND SAFETY AUDIT PROCEDURES

Regular health and safety audits will be conducted to ensure compliance with health and safety policy and procedures. The HSO will perform periodic audits, with the goal of one audit per shift, using the health and safety audit form (see Appendix N). Auditing may be performed on any ABB-ES site by the HSS or the HSM, and will include health and safety evaluations of all work activities. The audits will be an unannounced evaluation of sites selected at the discretion of the HSM or HSS, with the goal of 10 percent of active sites being subject to audits each quarter.

Results of each site health and safety audit will be summarized in an audit report provided to the site HSO, the Project Manager, and the Operational Group Manager charged with responsibility for the project. Where the audit report identifies deficiencies, it will be the Project Manager's responsibility to promptly implement corrective action. The corrective action undertaken will be outlined in a written report submitted to the HSS and the HSM. The HSM or the HSS will retain the original audit report that has been signed by the Project Manager and the HSO to acknowledge receipt of the audit's findings. Any mitigating comments submitted to the HSM or the HSS will be appended to the original report.

APPENDIX Q STANDARD OPERATING PROCEDURES

APPENDIX Q STANDARD OPERATING PROCEDURES

Q.1 STANDARD OPERATING PROCEDURES FOR THE USE OF EXPLOSIVES IN SEISMIC REFRACTION SURVEYS

Q.1.1 Introduction

This appendix lists some of the more important aspects of the purchase, transport, storage, handling, and use of explosives. it is intended as a general guide for ABB-ES personnel who may be involved in conducting seismic surveys or who may be overseeing or auditing such surveys. It is not intended as a stand-alone reference replacing appropriate federal and/or state regulations, which can be very specific about certain aspects regarding explosives.

Many recent advances in computer software and hardware and hardware technology have revolutionized data processing and interpretating in the seismic industry. Likewise, the recent development of sophisticated (and very expensive) truck-mounted energy sources that can scan a large range of frequencies for optimum response from deep reflecting horizons has made possible reflection surveys for hydrocarbon deposits to depths of up to 20 kilometers. However, for shallow (i.e., the upper several hundred feet) seismic refraction surveys, the best and most economical energy source continues to be small explosive charges detonated with electric blasting caps.

A small explosive charge, as defined herein, consists of the equivalent of from 1/8 to 1 pound of dynamite which is primed for detonation with one or more electric blasting caps. The "dynamite" that ABB-ES generally uses is KINESTIK 1/3, which consists of a powder and liquid, mixed on-site to form an explosive similar in performance to dynamite. Each stick (86 to a case) is equivalent to 1/3 pound of dynamite. Before mixing, the two parts re not considered by the DOT to he explosive; therefore, they can be shipped, transported, and stored with no special precautions. In practice, ABB-ES personnel should take every precaution to ensure that the powder and liquid are separated while being stored for any length of time to prevent unauthorized access to potentially explosive materials.

Electric blasting caps come in two configurations acceptable for seismographic work. The "seismograph" variety is best because of its repeatability with regard to delay time (i.e., the time that elapses between when the "fire" button on the blaster is depressed and when the blasting cap actually detonates). The other type is known as "instantaneous," and it has acceptable delay time characteristics. Blasting caps are graded by the federal government (and all states) a Class A explosive and must be handled and stored accordingly. Requirements for Class A explosive are discussed in the following subsection.

Q.1.2 Purchase, Transport, and Storage

The federal government has specific guidelines regarding the purchase, transport, and storage of explosives, particularly regarding interstate commerce. In addition, each state has developed regulations that supersede federal regulations if they are more restrictive. Therefore, the user must become familiar with federal as well as state regulations. In practice, it is unlikely that ABB-ES would ever become involved in interstate activities regarding explosives. In fact, it has been ABB-ES's practice to subcontract out-of-state blasting

activities to a local blaster to minimize expenses that would otherwise be incurred in obtaining necessary permits, and to eliminate time expended to purchase, transport, and store explosives. The following subsections pertain to State of Maine requirements. Other states can be and are different from Maine, and requirements vary widely.

Q.1.2.1 **Purchase**. In the State of Maine, a blasting license for an individual is not required. Such a license is required in Massachusetts (a competency license) and New York (an explosives license). However, the State of Maine does require a written permit, issued by the Commissioner of Public Safety, for the transport of explosives in intrastate commerce in quantities larger than 200 pounds of dynamite, or more than 500 electric blasting caps. Although ABB-ES never transport quantities exceeding these amounts, it has been company policy to obtain the State Permit to Transport Explosives, because it provides additional credibility to explosives vendors and local officials.

Before purchasing explosives in Maine, the user must obtain a permit from the fire marshal or appropriate local official in the town in which the explosives are to be used and/or stored. The local official must first establish the identity of the applicant, verify that he or she is older than 21 years of age and is a U.S. citizen, and inquire about the intended use of the explosives. Permitting thorough local officials can be as easy as a courtesy telephone call from the official notifying the local fire department or police chief (every town or city handles explosives permitting a little differently).

Before selling explosives, the state requires the vendor to verify that a valid permit has been issued to the buyer by the appropriate local town official. In addition, the vendor should ascertain whether the buyer can comply with the rules and regulations relative to the transport of explosives.

Q.1.2.2 **Transport**. Before issuing the State Permit to Transport Explosives, officials from the Department of Public Safety in Augusta, Maine, inspect the vehicle driven by the applicant to ensure that it is roadworthy. They also inspect the explosives magazine in which the explosives will be locked while in transit. State regulations require that the magazine be constructed of 1-and-1/2-inch-thick planking with no exposed metal on the inside (to eliminate sparks) and sheathed with NO. 24-gauge galvanized sheet steel. The magazine should have a strong hasp and padlock and be locked at all times when explosives are being transported. The magazine should also be chained and locked within the vehicle to prevent removal or shifting while under way. In addition, the vehicle should be equipped front and rear with two 1-quart (minimum) fire extinguishers suitable to extinguish electrical fires, and four diamond-shaped Class "A" explosives signs mounted on the front and rear and both sides of the vehicle. ABB-ES owns a "day" magazine and other equipment that meets these requirements.

Q.1.2.3 **Storage**. Regulations are very specific regarding storage. All that ABB-ES personnel need to remember is Class "A" explosives must be returned for storage to a permanent or temporary magazine before sunset on each day of usage. The ABB-ES day magazine is not a permanent or temporary magazine. A permanent magazine is a substantial structure located well away from dwellings and buildings where people work or congregate. It has walls 4 to 8 inches thick (depending on method of construction), strong doors with interior hinges, and double-shielded locks specially designed for storage magazines. The roof is construct^Ed to be bullet-proof, and foundation requirements are also specified. A temporary magazine is

usually a rather massive steel box (i.e., 350 to 500 pounds or more) on casters, lined with thick wood planking, with double-shielded locks. It should be securely fastened to the ground.

Q.1.3 Handling and Use

Safety should be the foremost consideration whenever explosives are being used. Seismic surveys routinely expend 20 to 30 sticks of dynamite (and an equal number of electric blasting caps) during a single field day. To mix the KINESTIK, mix one "tube" of the KINESTICK liquid (a clear red liquid composed of nitromethane) with one "stick" of white powder (ammonium nitrate), and allow to stand until the powder is thoroughly saturated with the liquid (it becomes pink); this takes 5 to 10 minutes. If the upper 4 feet of overburden are wet or saturated, it is a good idea to seal the stick (equipped with a screw cap) with tape to prevent contamination by groundwater. If groundwater enters the stick, it can cause the KINESTIK to misfire.

While the KINESTIK is being mixed, a series of shotholes (usually five) are prepared by driving a pointed 1-and-3/4-inch steel bar to the desired depth (from 2 to 4 or 5 feet) with a sledgehammer. The shothole depth depends on soil conditions and the anticipated size of the charge. Only when the explosives are ready to be placed at the bottom of a shothole, a blasting cap is placed in a molded cavity at the base of each stick. The blasting cap has two lead wires, usually 8 or 12 feet long, which are grounded together with a removable metal shield that should be left in place until the primed shot is ready to be fired. This prevents the induction of elect^Rc charge, which could accidentally fire the cap. The lead wires are used to connect the blasting cap to a double conductor (i.e., "shot") wire leading to the blaster. The cap is secured to the KINESTIK by two or more half-hitches with the two cap lead wires.

The explosive is not "primed" for detonation. After the primed shot is placed at the bottom of the shothole, a small amount of native soil (preferably sand) is placed in the hole and gently tamped with a tamping stick into the base of the hole over the primed explosive charge. A proper tamping stick is wooden (non-sparking), about 6 feet long and 1 to 1-1/4 inches in diameter (Note: dowel stock works well). The tamping procedure continues until a uniform column of native soil completely fills the shothole. One should be careful not to damage the cap lead wires during the tamping process.

The removal metal shield grounding the two cap lead wires together is removed only when the shot is ready to fire. Prior to making the connection between the cap lead wire and the shot wire leading to the blaster, the person making the connection should ascertain that the shot wire has been sorted out as the blaster by the party chief (operating the blaster) so that inadvertent detonation is not possible). While making the connection, the lead wires should be extended as far from the shothole as possible. The person making the connection should turn his or her back to the shothole, remove the metal grounding shield, and attach the shot wire leads (no polarity) to the cap wire leads.

As each shot is detonated, one person (usually the one making the connection) should be assigned to verify that no one is near the shot. The party chief should then call out, "Are you clear (of the shot)?" The response, "all clear" indicates that everything is ready and no one is close enough to be in any danger when the shot is detonated. A "safe" distance varies with soil conditions and the depth

of the shot; 75 to 100 feet is generally adequate. The party chief then calls out to everyone in the area, "Fire in the hole," and the charge is detonated.

If a misfire occurs (extremely rare), it is the responsibility of the party chief to remove the undetonated charge from the ground with a nonsparking shovel of wood or brass. The party chief is responsible for maintaining an explosives log that documents all explosives purchased, expended, stored, and destroyed. This log is subject to inspection at any time by local, state, and federal officials. It provides a record detailing the disposition of every cap and stick of dynamite (or KINESTIK) that comes under the control of ABB-ES personnel.

The amount of explosives that can be loaded into a shothole depends on the nature of the surface materials and the depth of the water table. Some general rules follow:

- use as few explosives as necessary to produce good quality data
- the more granular the soils, the more explosives will be required (to produce good data); the finer the soils, the fewer will be required
- the deeper the water table, the more explosives required, and vice versa
- the deeper the bedrock, the more explosives will be required, and vice versa

When ascertaining the proper explosive charge to produce good data at a new site, it is good practice to start with a single shothole well away from any buildings and power lines, and perform a test shot to determine local soil (an energy transmission) characteristics. Start with a small charge (e.g., half a stock of KINESTIK, obtained by mixing half the liquid from one tube with half the powder form one stick) buried to moderate depth (e.g., 3 feet) and increase (or decrease) the amount of the charge (and the depth of the shothole) as necessary.

Q.1.4 Use of Explosives at NTC, Orlando

If seismic refraction surveys utilizing explosives are conducted at NTC, Orlando, the purchase, storage, transportation, and handling of explosives will be subcontracted to a Florida licensed professional blaster. The blaster will be responsible for the safe handling, storage, and use of explosives in accordance with federal, state, and local regulations.

APPENDIX R RADIATION PROTECTION PROGRAM

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R.1 INTRODUCTION

The Radiation Protection Program addresses the work practices which personnel must follow in order to be protected from exposure to radiological hazards. Work practices must provide the protection necessary to keep the exposure levels as low as reasonably achievable (ALARA). Appendix I, Radiation Protection program includes the following items: types of radiation, general work practices, general area and personnel monitoring, bioassay program, environmental monitoring, sample collection and transportation, health and safety plan, training requirements, safety equipment and clothing, respiratory protection, and instrumentation.

The Radiation Protection program sets out procedures to protect workers from radiological hazards. The extent of the Radiation Protection program depends on the amount of contamination present above natural background radiation. At sites, where information cannot rule out the presence of radioactive material, monitoring with direct reading instruments for hazardous levels of ionizing radiation is necessary. Radiation monitoring is required using a Radiation Monitor 4 to measure radiation levels and dosimeter badges for personnel exposure. However, if a site has known contamination, a health physicist must give expertise in establishing the Radiation Protection program. The next section gives an overview of radiation hazards followed by a description of general work practices at potentially contaminated radioactive material sites.

R.2 TYPES OF RADIATION AND ASSOCIATED HAZARDS

There are five types of radiation. At hazardous waste sites, the following three types and their hazards may be encountered:

(1) An alpha particle is emitted from the nucleus of heavy atoms. It has a mass of 4 atomic mass units (amu): 2 protons and 2 neutrons. The slow moving alpha particles carry a positive charge. They cannot penetrate a piece of paper or skin but are very dangerous when substances emitting them are ingested or inhaled. Alpha particles present an internal hazard. An internal hazard causes damage inside the body and can occur through injection, inhalation, or absorption. Any particles inhaled will ionize living tissue.

(2) A beta particle is a charged particle emitted from the nucleus of the atom. It has a low mass and a (+) or (-) charge. It travels at one-tenth the speed of light, traveling faster than an alpha particle. Beta particles can penetrate paper or several millimeters of skin. Because of its smaller size and charge, beta particles have a lower probability of interaction with electrons, and therefore a greater ability to penetrate living tissue. Beta particles present both an internal and external hazard, although mostly an internal hazard. An external hazard causes damage inside the body from an outside source of radiation. Beta particles absorbed through the skin act in a similar manner as alpha particles. The lenses of the eye are also susceptible. A 1/4 to 1/2-inch shield of plexiglass or lead will shield most beta particles.

(3) Gamma radiation is electromagnetic radiation emitted from the nucleus of an atom. An unstable nucleus can remain unsettled, even after emitting an alpha or beta particle. It will rid itself of the electromagnetic radiation by emitting a gamma ray. A gamma ray is considered a photon with no mass or charge. It travels at the speed of light. Because the gamma ray does not have any charge or mass, there is little interaction with electrons. Therefore, gamma rays will penetrate through material very readily. Because gamma is a penetrating type of radiation, it presents an external hazard. This radiation also presents an internal hazard because gamma rays pass easily into the human body, damaging tissue in the process. An ionizing event occurs inside the body from a source outside the body.

R.3 GENERAL WORK PRACTICES

Before working in a potentially radioactive-contaminated work area, employees must have a thorough knowledge of the work practices in the site-specific HASP. The Health and Safety Officer (HSO) must consider all the possible hazards when developing the HASP.

R.3.1 General Area and Personal Monitoring

Personnel and general area monitoring strategies have been devised to ensure the identification of areas and work activities for which engineering controls or respiratory protection are required. Monitoring shall be conducted to confirm, that the levels of protection provided by engineering controls and by the respiratory protection program are adequate to protect the worker.

R.3.1.1 **General Area Monitoring.** General area monitoring assesses airborne contaminants in work areas and at the site boundary. Swipe and grab samples are collected to identify contamination on surfaces and equipment. Equipment that is adequate for monitoring needs shall be available, properly calibrated, and controlled. Depending on the operation, surveys shall be performed to determine the following: external radiation exposure levels, airborne concentrations of radioactive material, personnel contamination, surface contamination in work areas, contamination of personal protective equipment, and suitability for release of equipment and material to an unrestricted area.

R.3.1.2 **Personal Monitoring.** Personnel monitoring methods measure external and internal exposure to radioactive material. The type of personnel monitoring depends on the type of radiation, the type of work to be performed, and the condition of the work site.

The purpose of internal exposure monitoring is to determine whether and to what extent radionuclides have entered the body. Monitoring of radiation workers for internal contamination is necessary only in work situations where radioactive materials may become airborne, have the potential for ingestion, or could be absorbed through the skin. The most effective internal monitoring techniques are bioassay surveillance and air sampling.

R.3.1.2.1 **Bioassay Program.** Bioassay includes the measurement of radioactive material in the body to evaluate the radiation dose. The type and frequency of bioassay surveillance required for workers on site must be delineated based on

the air sampling results, quantity and chemical form of radioactive material, half-life, and detection sensitivity of the instruments.

A bioassay program will only be used when contamination levels are high enough and are readily dispersed into the air causing the radioactive material to be absorbed through the skin, inhaled, or ingested. The amount of contaminant that can be deposited in the body is based on the maximum permissible concentration hours (MPC-H). The MPC-H depends upon the concentration limits for each individual radionuclide listed in 10 CFR 20, Appendix B.

Any time an ABB-ES employee enters a site where there is a potential for radioactive contamination or an unknown hazardous waste site, he or she must be monitored for external radiation exposure by means of personal dosimeters. These personal dosimeters or badges monitor any exposure to penetrating radiation (beta and gamma) and are changed quarterly. Exposure records are kept for total lifetime doses.

Radiation workers may request a copy of their exposure records. Former employees may request a written summary of their exposures or request that the information be forwarded to a subsequent employer.

Respiratory protection is used only if engineering controls and work practices do not adequately protect workers.

R.3.2 Environmental Monitoring

Contaminants of concern may be present in soil; in air as a result of suspension from soil, groundwater, or transient surface water; or bound to existing surfaces.

All work sites will be surveyed for any surface contamination above background levels. As work is being conducted in an area, radiation survey meters will be used to scan personnel and equipment before leaving the work area. Various instruments will be used (i.e., portable radiation survey instruments), typically ratemeters with scintillation detectors, proportional counters, or Geiger-Mueller counters.

Soil and water samples will be screened in more detail to determine the type and amount of radioactive material in the samples. The characterization of the contaminant depends on the capabilities of the instrumentation. A scaler/counter is used for a specified time period to determine the amount of radioactive material in each sample. With unknown contaminants, further analysis is necessary.

R.3.3 Sample Collection and Transportation

When necessary, all samples will be analyzed for any presence of radioactive material before shipment to an environmental laboratory. Any sample over a certain limit of radioactivity is to be considered radioactive material. Federal regulations require that the owner of the material (licensee) is responsible for the shipment of the material. The shipment must be made under the licensee's name. Any facility contracted to perform the analysis of the samples must have a specific state or federal license to receive radioactive material. The facility must be licensed to handle the radionuclide and the quantity that is in the sample.

R.4 HEALTH AND SAFETY PLAN

The Health and Safety Plan (HASP) has been developed to provide the practical health and safety framework for all field operations. The HASP complies with regulations under the Occupational Safety and Health Act, 1910.120.

The HASP for the site shall address radiological hazards and present the guidelines to be followed for all field activities.

The HASP must address the following situations: training, environmental and personal monitoring, equipment collection and transportation of samples, and work practices.

R.5 TRAINING REQUIREMENTS

All site workers shall be trained to work in accordance with 29 CFR 1910.120. If there is radioactive contamination, then site-specific training will include radiological hazards.

Items that may be covered depending on the severity of contamination are as follows:

(1) Introduction

(2) Radiation fundamentals

(3) Types of radiation and their characteristics

(4) Units of measure of radiation.

(5) Radiation exposures from natural, and man-made sources

(6) Biological effects

(7) Radiation effects and risks

(8) Radiation protection fundamentals - time, distance, shielding

(9) Exposure and contamination limits

(10) Monitoring equipment

(11) Radiation protection plans and procedures

R.6 SAFETY EQUIPMENT AND CLOTHING

The safety equipment and clothing used for chemical hazards is capable of safeguarding against radiological hazards.

R.6.1 Respiratory Protection

The level of respiratory protection will be determined from the results of the air monitoring.

R.7 INSTRUMENTATION

There is only one way to detect and measure radiation and that it is through instrumentation. Instruments used in detecting radiation serve various purposes. Therefore, there is a wide variety of instrument types.

Choosing an instrument depends on portability; mechanical ruggedness; ease of use, reading, servicing; ease of decontamination; reliability; and hazardous waste site work conditions and work practices. Choice also depends on the ability to respond to the radiation being measured, measurement sensitivity at the desired level, response time, and energy dependence. Factors that effect radiation instrument readings are counting geometry, dead time, and the type and energy of radiation.

The instrumentation is calibrated in accordance with manufacturer's specifications.

Some instruments that may be used in the field are **radiation survey meters** and **counters**; both have a specific detector for the desired radiation. Detectors are classified in the following categories: gas-filled detectors including ionization chambers, proportional counters, and Geiger-Mueller counters; and scintillation detectors including inorganic crystals, liquid phosphors, and semiconductor devices.

Radiation survey meters are used to detect environmental, personnel, and equipment contamination. **Counters** are used for scanning environmental samples and wipes to determine the presence of any radioactive material in the samples or on surfaces where the wipe was taken. An evaluation of radiological hazards found at the site must be made by a Health Physicist.

APPENDIX S BLOODBORNE PATHOGEN EXPOSURE CONTROL PLAN

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S.1 INTRODUCTION

On December 6, 1991, the Occupational Safety and Health Administration (OSHA) issued a final standard on Occupational Exposure to Bloodborne Pathogens. This standard is intended to protect all workers who may reasonably anticipate being occupationally exposed to blood and other potentially infectious materials. Occupational exposure means a "reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of the workers duties."

ABB-ES has developed this EXPOSURE CONTROL PLAN (ECP) to help protect its associates from being inadvertently exposed to the hepatitis B virus (HBV) or human immunodeficiency virus (HIV). This ECP applies to all associates bearing current first aid or cardiopulmonary resuscitation (CPR) certification or who will work at a hazardous waste site containing medical wastes. The ECP supplemented by training will help associates become aware of the hazards to which they may be exposed and how to reduce exposure incidents. This plan will be reviewed and updated at least annually, or whenever necessary, to reflect new or modified tasks and procedures affecting occupational exposure. In addition, site-specific procedures must be addressed in the Health and Safety Plan HASP for all sites potentially containing medical wastes.

S.2 EXPOSURE DETERMINATION

During the normal course of their work, ABB-ES associates would not routinely become exposed to bloodborne pathogens (e.g., viruses). Circumstances where exposure may occur would be when providing first aid/CPR treatment (see Personnel Master Training List for associates currently certified) or when working at a hazardous waste site containing medical wastes. (Note: Project Assistants who are in health monitoring and have received Project Assistant training and who will be handling samples potentially contaminated with bloodborne pathogens will also be covered by the standard.)

S.2.1 Routes of Exposure

The infectious process can best be compared to a chain with six interrelated links, all of which must be present for an infection to take place.

S.2.1.1 Infectious Agent. The first link is the etiologic agent itself. This would include any bacterium, fungus, virus, or other microorganism. Not only must the organism must be present, it must also be pathogenic and present in sufficient quantity to provide an infective dose. Seldom, if ever, has the transmission of disease resulted from the transfer of a single microorganism. It usually requires thousands to millions of such agents before infection can take place. The actual number required depends on the pathogen in question.

S.2.1.2 Reservoir. The second major link is the presence of a reservoir or source that allows for microbial survival and, perhaps, even multiplication of a potential pathogen. Common reservoirs would include not only humans, but also

the equipment used in medical treatment. While HIV cannot survive long outside the body, HBV becomes dormant and can survive for years.

S.2.1.3 **Portal of Exit.** The third link is the presence of a source from which the pathogen can emerge, a portal of exit. Obvious portals of exit include the respiratory tract, vascular system, skin and mucous membranes, as well as the gastrointestinal tract and genitourinary tracts. Each of these portals of exit is particular to a given disease. For example, tuberculosis and influenza would involve only the respiratory tract, and typhoid fever the gastrointestinal tract.

S.2.1.4 **Mode of Transmission.** The fourth link, a mode of transmission, is one over which there is a great deal of control. This link is, by far, the easiest to break. Transmission can occur in one of four ways: contact; airborne; vehicular; and vector (vector transmission involves the transmission of pathogens via insect, animal, or plant vectors) modes of spread.

The transfer of infectious agents through vehicular means (e.g., food or water borne) is not a common event. Nonetheless, it can and does occur.

The airborne route transmits many diseases (e.g., tuberculosis, measles, mumps, and chicken pox). Controlling the airborne spread of disease usually involves good ventilatory patterns and caution when coming into close proximity with infected individuals (e.g., when providing first aid or CPR).

The major mode of disease transfer is contact transmission. This takes place either through direct or indirect contact, or through droplet spread involving contact with exhaled respiratory secretions. Direct contact, person-to-person transmission, is primarily person-to-person spread through actual physical contact. Indirect contact transmission can be the result of contact with a contaminated, intermediate object such as medical wastes in a landfill. Droplet spread can occur as the result of contact with respiratory secretions through means such as sneezing or coughing.

S.2.1.5 **Portal of Entry.** The fifth link in the chain is a suitable portal of entry. As with chemical exposures, these portals are inhalation, ingestion, dermal, and injection. Most infectious diseases and infectious conditions require very specific portals of entry.

S.2.1.6 **Susceptible Host.** The last major link involves the necessity for a susceptible host, someone who lacks effective resistance to a given pathogenic agent. A variety of host factors must be met before infection can occur. Very few organisms can gain entrance through normal intact skin. Most require some breach in skin integrity. Other less obvious lines of defense include tears, gastric acid, and cilia of the nose and upper respiratory tract. One's ability to mount a local inflammatory response provides yet another non-specific host defense mechanism.

There are, however, several biologic factors that decrease, rather than increase, a resistance to infection. Extremes in age, either the very young or very old, are associated with decreased resistance. Other factors such as major surgery and the presence of chronic diseases -diabetes, neoplasia, blood disorders - alter host resistance.

Malnutrition, anemia, and chronic alcoholism also have pronounced effects on the ability to combat disease.

S.2.2 Bloodborne Pathogens of Concern

S.2.2.1 Hepatitis B Virus. The term "hepatitis" simply means an inflammation of the liver. This condition can be caused by a wide variety of agents, including medication, alcohol, toxic or poisonous substances, and infectious agents such as viruses. Hepatitis B, formerly known as "serum" hepatitis, is the only form of viral hepatitis that poses a significant occupational threat.

Nationwide, there are approximately 300,000 new cases of hepatitis B infection each year and about 5,000 deaths caused by this disease. Approximately 5 percent of the entire U.S. population, more than 12 million people, have been infected. The carrier rate is approximately 10 percent. It is estimated that, in the United States alone, there are approximately 750,000 to 1,000,000 asymptomatic carriers of the virus. The hepatitis B virus has been found in blood, semen, vaginal secretions, breast milk, saliva, and serous fluid. In occupational settings, the major route into the body is from blood or blood-contaminated bodily fluids splashed into the eyes, mucous membranes, or mouth.

There is a direct relationship between the likelihood of occupational hepatitis B infection and the frequency of blood contact. It is the frequency of blood contact that establishes the level of risk of being infected with HBV.

S.2.2.2 Human Immunodeficiency Virus. Acquired immunodeficiency syndrome or AIDS is a severe viral disease. AIDS severely affects the immune system and is characterized by a multitude of opportunistic infections. The AIDS or HIV virus is typical of most viruses in that it cannot survive for any appreciable amount of time outside its human host. Its presence in the general environment is extremely unlikely and occupationally would be limited to body secretions, primarily blood. Being an unstable virus, HIV is very susceptible to a large number of common household disinfectants.

Over the past decade, approximately 210,000 cases of AIDS have been reported in the United States. In addition, an estimated 1 million individuals have been infected with the virus but have not yet developed the disease. It is important to remember that these individuals are generally without symptoms, yet they are carriers of the virus and thus potentially infectious.

S.3 METHODS OF CONTROL

As a result of increased epidemiologic knowledge concerning HIV and HBV transmissions, the Centers for Disease Control recommended that all blood or bodily fluids be considered potentially infectious. This approach has come to be known as "Universal Precautions." The concept of Universal Precautions recognizes that medical histories and examinations cannot reliably identify all patients infected with HIV or other bloodborne pathogens nor can you recognize those individuals on site, thereby dictating certain precautionary measures when providing first aid or CPR to any worker.

Wherever feasible, engineering and work practice controls will be used to eliminate or minimize employee exposure. Where occupational exposure remains

after institution of these controls, personal protective equipment will also be used.

S.3.1 Engineering Controls

If engineering controls are utilized (e.g., remote handling of contaminated materials), they will be examined and maintained or replaced on a regular schedule to confirm their effectiveness.

S.3.2 Work Practices

Work practices that will be used at sites with include:

1. Handwashing facilities with soap and running water. If a site does not have access to running water, an antiseptic hand cleanser in conjunction with clean cloth/paper towels or antiseptic toweletts will be provided. When antiseptic hand cleansers or toweletts are used, hands shall be washed with soap and running water as soon as feasible.

2. No eating, drinking, smoking, applying lip balm or cosmetics, and handling contact lenses are allowed in the Exclusion Zone or immediately after providing first aid or CPR.

3. Associates are to wash their hands, or any other exposed skin, with soap and water as soon as feasible after any exposure to any potentially infectious material and before eating, drinking, smoking, applying lip balm or cosmetics, and before handling contact lenses. Flush mucous membranes with water immediately or as soon as feasible following body contact with blood or any other potentially infectious material.

4. Equipment that is contaminated with blood or other potentially infectious material will be decontaminated prior to exiting the Exclusion Zone or as soon as feasible after providing first aid treatment. Equipment that cannot be decontaminated immediately will be labeled as a biohazard until such a time as decontamination can take place.

5. All procedures involving blood or other potentially infectious materials will be performed in such a manner as to minimize splashing, spraying, spattering, and generating droplets of these substances.

6. Samples containing potentially infectious material shall be placed in a container that prevents leakage during collection, handling, processing, storage, transport, or shipping. If outside contamination of the primary container occurs, the primary container shall be placed within a second container that also prevents leakage.

S.3.3 Personal Protective Equipment

Modified Level D (Level C - dermal) is the minimum level of personal protection to be used at a hazardous waste site suspected to contain medical wastes. When

providing first aid treatment, gloves, safety goggles/glasses, and coveralls/tyveks will be worn at a minimum. Level C or B can be used if face shields are unavailable.

Personal protective equipment (PPE), is only considered appropriate if it does not permit blood or other potentially infectious materials to pass through or to reach an associate's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time the protective equipment is used. First aid kits will be stocked with safety glasses, gloves, and disposable mouthpieces (with one-way valves) for use when providing CPR.

All PPE will be removed before leaving the Exclusion Zone or immediately after first aid treatment has concluded. All disposable PPE will be collected and labeled as a biohazard and disposed of properly. ABB-ES will collect, bag, and label (red bags or bags with biohazard label), launder, and decontaminate all non-disposable PPE. Should blood or other potentially infectious materials penetrate the garment, the worker will remove it immediately or as soon as feasible.

S.3.3.1 **Gloves**. Gloves shall be worn when it can reasonably be anticipated that the associate may have hand contact with blood, other potentially infectious materials, mucous membranes, and non-intact skin; or when handling or touching contaminated items or surfaces. The gloves typically used at hazardous waste sites are acceptable.

S.3.3.2 **Eye Protection and Face Shields**. Eye protection devices, such as goggles, or glasses with solid side shields, or chin-length face shields, shall be worn whenever splashes, spray, spatter, or droplets of blood or other potentially infectious materials may be generated.

S.3.3.3 **Protective Clothing**. Clothing such as, but not limited to, tyveks, polycoated tyveks, aprons, and coveralls, or similar outer garments shall be worn when providing first aid or working on a site where medical wastes are suspected or known to be. The type of clothing selected will be based on the task, degree of exposure anticipated, and other hazards (e.g., chemicals) present at the site.

S.4 DECONTAMINATION AND DISPOSAL

S.4.1 Decontamination

All equipment and work surfaces shall be cleaned and decontaminated after contact with blood or other potentially infectious materials. Contaminated work surfaces shall be decontaminated with an appropriate disinfectant (such as chlorine bleach) after completion of procedures; immediately or as soon as feasible when surfaces are overtly contaminated or after any spill of blood or other potentially infectious materials; and at the end of the work shift. Protective coverings, such as plastic wrap, aluminum foil, or imperviously-backed absorbent paper used to cover equipment and environmental surfaces, shall be removed and replaced as soon as feasible when they become overtly contaminated or at the end of the day.

All bins, pails, cans, coolers, etc., intended for reuse that have a reasonable likelihood for becoming contaminated with blood or other potentially infectious

materials shall be inspected, decontaminated, and disinfected (with chlorine bleach) immediately or as soon as feasible.

Broken glassware or other sharp objects that may be contaminated shall not be picked up directly with hands. These shall be cleaned using mechanical means, such as a brush and dust pan, tongs, shovel, etc.

S.4.2 Disposal

Contaminated sharps (e.g., broken sample bottles) shall be discarded immediately or as soon as feasible in containers that are: (1) closable; (2) puncture-resistant; (3) leakproof on sides and bottom; and (4) labeled or color-coded.

Other regulated wastes (e.g., gloves, tyveks) shall be placed in containers that are: (1) closable; (2) constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping; (3) labeled or color-coded; and (4) closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping. If outside contamination of the regulated waste container occurs, it shall be placed in a second container that meets the qualifications of the primary container.

Disposal of all regulated wastes shall be in accordance with applicable regulations.

S.4.3 Laundry

Disposable items shall be used whenever possible. In the event that coveralls or street clothing becomes contaminated with potentially infectious materials, it shall be laundered by a facility capable of handling potentially infectious materials.

Contaminated laundry shall be handled as little as possible with a minimum of agitation. All contaminated laundry shall be bagged or containerized <u>without being sorted or rinsed</u> at the location where it was used. Contaminated laundry shall be placed and transported in bags or containers labeled or color-coded. Whenever contaminated laundry is wet and presents a reasonable likelihood of soak-through of or leakage from the bag or container, the laundry shall be placed and transported in bags or containers that prevent soak-through and/or leakage of fluids to the exterior. All associates who have contact with the laundry shall wear protective gloves and other appropriate PPE.

S.5 LABELS

Signs and labels used to indicate potentially infectious materials must include the following legend:

These labels shall be fluorescent orange or orange-red or predominantly so, with lettering or symbols in contrasting color and affixed as close as feasible to the container by string, wire, adhesive, or other methods that prevents their loss or unintentional removal.

Warning labels containing the above symbol must be affixed to containers of regulated waste, coolers, laundry bags, or other containers used to store,

transport, or ship blood or other potentially infectious materials. A substitute for labels is the use of red bags or containers. These can be used to differentiate between infectious and non-infectious materials as long as all associates at the site are aware of its meaning.

Labels required for contaminated equipment will contain the biohazard symbol and shall also state which portions of the equipment remain contaminated.

S.6.0 TRAINING

All associates maintaining current certification in first aid and/or CPR as well as associates who are assigned to a site potentially contaminated with medical wastes will be trained in the contents of this ECP. This training will include:

1. The hazards involved from being exposed to potentially contaminated blood and other bodily fluids, including a general explanation of the epidemiology and symptoms of bloodborne diseases and an explanation of the modes of transmission of bloodborne pathogens.

2. The hepatitis B vaccine.

3. Appropriate work practices and engineering controls.

4. Proper personal protective equipment.

5. Proper housekeeping, transportation, and disposal of contaminated wastes and proper disposal or laundering of personal protective equipment.

6. Actions to take if worker comes in contact with blood or other potentially infectious material.

7. An explanation of the signs, labels, and/or color-coding required.

Training will be done at the time of initial employment and annually thereafter during refresher training courses. Additional training will be conducted when working at sites suspected of containing medical wastes or when otherwise needed.

S.7 EXPOSURE INCIDENT

S.7.1 Vaccination

All associates working at hazardous waste sites where medical wastes are a potential contaminant and who will be working in the Exclusion Zone, handling samples, or who otherwise may come in contact with potentially contaminated materials, must be offered a Hepatitis B vaccination series 10 days prior to working at the site. In addition, all associates who, during the course of providing first aid or CPR, come in contact with blood or other potentially infectious bodily fluids, are to be offered a hepatitis vaccine within 24 hours of exposure regardless of whether PPE was worn.

S.7.2 Exposure Notification

Should an occupational exposure to blood or other potentially infectious bodily fluids occur, the Health and Safety Manager (HSM) will be notified immediately. Should the exposure occur after normal hours or over the weekend, the Health and Safety Officer (HSO) will contact our health monitoring provider, Environmental Medicine Resources (EMR) at 1-800-229-3672 to arrange for the hepatitis B vaccine at a nearby clinic or hospital. Exceptions to this policy are only for associates who have already received the complete vaccine series and antibody testing has revealed that they are immune, or if the vaccine is inadvisable for medical reasons.

If the associate declines the hepatitis B vaccination, the associate must sign the "Hepatitis B Vaccine Declination" statement (Figure J-2) before being allowed to work at the site or within 24 hours of exposure after providing first aid or CPR.

Any associate who initially declines the vaccine is still eligible to take it at a later date. The vaccine will be available at no charge to the associate.

S.7.3 Post-Exposure Evaluation and Follow-up

Hepatitis B vaccinations are available, at no charge, to all ABB-ES associates who have current certification in first aid or CPR and have had an occupational exposure to blood or other potentially infectious bodily fluids or who work at sites where there is a potential for an exposure to medical wastes.

After the occurrence of an occupational exposure, a post-exposure follow-up examination will occur. All medical evaluations and procedures are performed under the supervision of EMR and will be conducted at the health monitoring clinic normally used by ABB-ES associates or a clinic or hospital near the site. All evaluations, procedures, vaccinations, and post-exposure management will be conducted according to current standard recommendations of U.S. Public Health Service.

Following a report of an exposure incident, each associate will immediately receive a confidential medical evaluation and follow-up. Included in this examination will be the following elements:

1. Documentation of the route(s) of exposure, and the circumstances under which the exposure incident occurred.

2. Identification and documentation of the source individual, unless ABB-ES can establish that identification is infeasible or prohibited by state or local law.

3. Testing the source individual's blood as soon as possible for HBV. Testing for HIV is performed only after consent is obtained. If consent is not obtained, document that legally required consent cannot be obtained as needed. When the source individual is already known to be infected with HBV or HIV, this testing does not need to be repeated.

4. Results of the source individual's testing will be made available to the exposed associate, and the associate will be informed of

applicable laws and regulations concerning disclosure of the identity and the infectious status of the source individual.

5. The exposed associate's blood will be collected and tested after consent is obtained. If the associate consents to baseline blood collection but does not give consent at that time for HIV serologic testing, the sample is preserved for at least 90 days. If within 90 days of the exposure incident, the associate elects to have the baseline sample tested, the testing is done as soon as feasible.

6. High-risk exposure involves blood or body fluids introduced through intact skin or splashed onto mucous membranes or broken or abraded skin of the associate. Any associate sustaining a high-risk exposure should notify the HSM immediately.

7. Follow-up of the exposed associate includes any or all of the following: (a) antibody or antigen testing; (b) counseling; (c) illness reporting; and (d) safe and effective post-exposure measures to prevent the spread of disease.

8. EMR already has or will be provided the following information:

   a. A copy of the Bloodborne Pathogen Standard and it's appendices (29 CFR 1910.1030).

   b. A description of the affected associates's duties as they relate to the exposure.

   c. Documentation of the route(s) of exposure and circumstances under which exposure occurred.

   d. Results of the source individual's tests if available.

   e. All medical records relevant to the appropriate treatment of the associate including vaccination status.

9. A physician's written opinion will be sent to the associate with a copy to the HSM within 15 days of the completion of the evaluation. The written opinion to the HSM will be limited to:

   a. the physician's recommended limitations on the associate's ability to receive hepatitis B vaccination;

   b. a statement that the associate has been informed of the results of the medical evaluation; and

   c. a statement that the associate has been told about any medical conditions resulting from exposure to blood or other potentially infectious materials that require further evaluation or treatment.

All other findings and diagnoses will remain confidential and will not be included in the HSM's copy of the written report.

S.8 DEFINITIONS AND ACRONYMS

ABB-ES - ABB Environmental Services, Inc.

AIDS - Acquired Immunodeficiency Syndrome

BLOOD - Human blood, human blood components, and products made from human blood.

BLOODBORNE PATHOGENS - Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

CONTAMINATED - The presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

CONTAMINATED LAUNDRY - Laundry which has been soiled with blood or other potentially infectious materials or may contain sharps.

CONTAMINATED SHARPS - Any contaminated object that can penetrate the skin, including, but no limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wire.

CPR - Cardiopulmonary resuscitation

DECONTAMINATION - The use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or items is rendered safe for handling, use, or disposal.

ECP - Exposure Control Plan

EMR - Environmental Medicine Resources, Inc.

ENGINEERING CONTROLS - Controls that isolate or remove the bloodborne pathogens from the workplace.

EXPOSURE INCIDENT - A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties.

HANDWASHING FACILITIES - Facility providing an adequate supply of running potable water, soap, and single-use towels or hot-air drying machines.

HASP - Health and Safety Plan

HBV - Hepatitis B virus.

HIV - Human immunodeficiency virus.

HSM - Health and Safety Manager

HSO - Health and Safety Officer

OCCUPATIONAL EXPOSURE - Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from performance of an associate's duties.

OSHA - Occupational Safety and Health Administration

OTHER POTENTIALLY INFECTIOUS MATERIALS - are defined as:

1. The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.

2. Any unfixed tissue or organ (other than intact skin) from a human (living or dead).

PARENTERAL - Piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

PERSONAL PROTECTIVE EQUIPMENT (PPE)- Specialized clothing or equipment worn by an associate for protection against a hazard. General work clothes (e.g., uniforms, pants, shirts, or blouses) not intended to function as protection against a hazard are not considered to be personal protection equipment.

REGULATED WASTE - Liquid or semiliquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semiliquid state if compressed; items caked with dried blood or other potentially infectious materials that are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes.

SOURCE INDIVIDUAL - Any individual, living or dead, whose blood or other potentially infectious materials may be a source of occupational exposure to the employee. Examples include, but are not limited to, hospital and clinic patients, clients in institutions for the developmentally disabled, trauma victims, clients of drug and alcohol treatment facilities, residents of hospices and nursing homes, human remains, and individuals who donate or sell blood or blood components.

STERILIZE - Use of physical or chemical procedures to destroy all microbial life, including highly resistant bacterial endospores.

UNIVERSAL PRECAUTIONS - An approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

WORK PRACTICE CONTROLS - Controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., by prohibiting recapping of needles, using a two-handed technique).

Figure S-1: Biohazard Symbol

ABB ENVIRONMENTAL SERVICES, INC.

DECLINATION FORM FOR HEPATITIS B VACCINE

I understand that due to my occupational exposure to blood and other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine at no charge to me. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with hepatitis B vaccine, I can receive the vaccination series at no charge to me.

Employee Signature:_____

Social Security Number:_____

Date:_____

Signature of Witness:_____

Figure S-2: Declination Form For Hepatitis B Vaccine

APPENDIX T UNEXPLODED ORDNANCE (UXO)

APPENDIX T UNEXPLODED ORDNANCE (UXO)

T.1 INTRODUCTION

There are a variety of Safety precautions, both general and specific, which relate to Ordnance Explosive Waste Hazardous/Non-hazardous (OEW) operations. These related safety precautions should be consulted and complied with, as appropriate to the operation or situation. By their nature, OEW operations are hazardous and certain calculated risks must be taken such as, ingenuity, judgement, common sense and, above all the mastery of Explosive Ordnance Disposal (EOD) techniques and observance of EOD principles will determine success or failure. The below listed safety precautions are general in nature and are applicable to EOD/OEW operations involving ordnance of all nations.

T.2 GENERAL SAFETY PRECAUTIONS

The following general safety precautions are applicable to OEW related operations.

- During EOD/OEW operations only the minimum number of personnel essential to the operation should be present in the vicinity. EOD/OEW operations will normally be conducted by a minimum of two EOD technicians.

- Do not allow unauthorized or unnecessary personnel to be present in the vicinity of possible hazardous explosive ordnance or when EOD/OEW operations are pending or in progress.

- Personnel working with explosives and explosive ordnance shall comply with the following:

  - Do not carry fire or spark-producing devices on site.
  - Do not smoke, except in authorized areas.
  - Do not have fires for heating or cooking, except in authorized areas.
  - Do not conduct operations without approved Standard Operating procedures (SOP) and proper supervision.
  - Do not become careless by reason of familiarity with ammunition.
  - Do not conduct explosive operations during electrical, sand, dust, or snow storms.
  - Do not conduct explosive operations between sunset and dawn.

- A records search should indicate the possibility of encountering foreign Unexploded Ordnance (UXO), ordnance containing toxic chemicals, or experimental ordnance on the work site. Remember that some foreign UXO has been returned to the United States for exploitation, test firing, and disposal. If the records search indicates that UXO containing military toxic chemical agents may be on the site, a decontamination plan shall be approved prior to entry onto the site. If a chemical UXO is encountered, the 2-man concept is immediately implemented and notification shall be made through proper channels. EOD personnel shall immediately establish and

maintain security of the UXO and the immediate vicinity until military authorities arrive and assume custody.

- In dealing with an unknown type of ordnance, past experience, conditions of delivery, and probable or obvious targets will usually provide a clue as to the type of ordnance. However, considerations should include:

  - The most hazardous type it could be.
  - The most hazardous feature it could contain.
  - The most hazardous condition it could be in.

- Make every effort to identify the ordnance before performing any procedures. However, do not move the item to inspect it unless absolutely necessary and then move it using remote means. Remotely conduct any initial movement or jarring of a possibly hazardous munition or item.

- Care must be observed in probing for, moving, and handling UXO. Do not depress plungers, turn vanes, or rotate spindles, levers, setting rings, or other fittings on the ordnance.

- Do not disassemble or subject any UXO to unnecessary movement, except in response to a valid requirement.

- Personnel preparing to work on possible live ordnance that could contain electrical elements shall momentarily ground themselves before touching the ordnance.

- The site shall be surveyed for electromagnetic radiation (EMR) radio frequency transmitters and appropriate action taken. Safe distances have been established for specific transmitter power and transmitters. These distances shall be made available to the contractor by the Huntsville Division of the Corps of Engineers.

- Do not take magnetic tools or equipment near and unidentified object until it can be absolutely determined that the object is not magnetically functioned.

- Do not wear outer or undergarments made of wool, silk, or synthetic textiles such as rayon and nylon white working on UXO. These materials can generate sufficient static charge to ignite fuels or initiate explosives. Any person coming in contact with an UXO shall ground himself prior to touching Electroexplosive Device (EED). This must be done to discharge any electrostatic charge accumulation from the body.

- Consider explosive ordnance which has been exposed to fire as extremely hazardous. Chemical and physical changes may have occurred to the contents, which render it much more sensitive.

- Avoid inhaling and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials. Do not get in the smoke of burning explosives, including solid propellants. The smoke will

penetrate ordinary clothing. Severe dermatitis, as well as eye and respiratory irritation, can result. If the smoke cannot be avoided, wear protective clothing and a self contained breathing apparatus. Wear gloves and wash thoroughly with soap and water as soon as possible after handling known/unknown explosives and propellants.

- Do not ingest any explosive material; most are poisonous if taken internally. Do not inhale the gaseous products of high explosive detonations (certain types of gases produced are poisonous).

- Do not subject any explosive-loaded item of ordnance to shock or rough handling.

- Protect explosive-loaded ordnance and explosive-loaded components from extremes of heat, including the direct rays of the sun.

- Do not carry explosives or explosive components in pockets or elsewhere on the body, unless in special containers designed and approved for this purpose.

- Do not permit smoking, matches, or other sources of fire or flame within 100 feet of an area in which explosives or explosive-loaded ordnance is being handled.

- Exercise extreme caution in dealing with old, damaged, and possibly deteriorated explosive-loaded ordnance. Certain explosives, notably, picric acid and ammonium picrate, may react with metals, other explosives, air, or chemicals in the earth to produce extremely sensitive explosive compounds.

- Do not rely on the color coding of UXO for positive identification of contents. Munitions having none, incomplete, or improper color coding have been encountered.

- Assume a practice UXO contains a live charge it can be determined otherwise.

- Avoid the area forward of the nose of a munition until it can be determined that the item is not a shaped charge, High Explosive Anti-Tank (HEAT) UXO. The explosive jet can be fatal to great distances forward of the longitudinal axis of the item.

- Assume any shaped charge munition to contain a piezoelectric (PZ) graze sensitive fuzing system until the fuzing is otherwise identified. A PZ graze sensitive fuze is extremely sensitive. It can fire at the slightest physical change, and may remain hazardous for an indefinite period of time.

- Anticipate a detonation when burning any explosive. Certain low explosives, such as black powder, casting powders, and solid propellants having a nitrogen content can react under certain conditions with a violence approaching a high order detonation.

- Civil War projectiles shall be treated as any other UXO, especially projectiles with uncut Bormann time fuses and projectiles with percussion fuses, brass in particular. These have generally provided a watertight seal, even if they have been in the ground over one-hundred years. No projectile should be exposed to excess heat. The ignition point of black powder, used as a bursting charge in all Civil War projectiles, is 457 degrees F. Under no circumstances should an attempt be made to drill a hole in a projectile, either through the fuse or the body of the projectile.

T.3 EXCAVATION OF UNEXPLODED ORDNANCE

- The usual method for uncovering buried UXO is to excavate by hand. Hand excavation is the most reliable method for uncovering UXO, but unless the UXO is very near the surface, hand excavation exposes more people to the hazard of detonation for a longer period of time than any other method.

- Earth moving machinery (EMM) may be used to excavate for buried UXO, if the UXO is estimated to be deeper than 12 inches. EMM shall not be used to excavate within 12 inches of an UXO. When excavation gets within 12 inches of an UXO, hand excavation shall be used to uncover the UXO.

- Excavation shall comply with the provisions of 29 CFR 1926 subpart P.

- Perform initial movement of an embedded projectile remotely. First movement of an embedded projectile may cause fuze functioning. During this remote operation, precautions shall be taken for a high-order detonation.

- UXO which penetrates the earth to a depth where the force of the explosion is not enough to rupture the earth's surface forms an underground cavity called a camouflet. Camouflets will be filled with the end product of the explosion, carbon monoxide gas. Camouflet detection and precautions must be considered if records search indicates the site was used as an impact area.

T.4 SAFETY PRECAUTIONS FOR FUZES

- Before any movement of an UXO, the fuze condition must be ascertained. If the condition is questionable, consider the fuze armed. The fuze is considered the most hazardous component of UXO, regardless of type or condition.

- Observe magnetic and acoustic precautions when approaching and unidentified fuze.

- Avoid any unnecessary movement of an armed fuze. Perform any initial movement of an armed fuze remotely and avoid any unnecessary movement of an armed fuze.

- Do not disturb a piezoelectric firing crystal in any way.
- When transporting a possible armed fuze, position the fuze in the most neutral orientation possible.
- Do not subject a mechanical time fuze to any unnecessary movement.
- Do not attempt to reset an adjustable clockwork fuze.
- Do not turn off or on any source of radio frequency or any rapidly alternating electric current in the vicinity of a known or suspected proximity variable time (VT) fuze.
- Do not approach a proximity VT fuze until the prescribed waiting period has elapsed, and then approach from the rear.
- Keep a fuze which has been removed from ordnance, separated from other explosive ordnance.

T.5 PRECAUTIONS FOR PYROTECHNICS AND INCENDIARY MUNITIONS

- Protect the eyes by number 6 shade welders goggles, or equivalent, if visual exposure to burning pyrotechnic material is probable.
- Use sand to smother incendiary fires. Water may induce a violent reaction or be completely ineffective.
- Bury the incendiary-loaded munitions in sand when transporting. This will smother any fire which may start until other corrective actions can be taken.
- Anticipate a high-order detonation when burning pyrotechnic or incendiary loaded ordnance.
- Do not approach a pyrotechnic or incendiary ordnance burn for 30 minutes after cessation of burning.
- Do not attempt to dispose of photoflash munitions by burning.
- Do not look directly at photoflash munitions during disposal operations.
- Photoflash powder is extremely sensitive, as it contains black powder and aluminum.
- Use oil or WD-40 to desensitize spilled photoflash powder.
- Do not manually remove fuzes from munitions containing photoflash powder.
- Photoflash powder generates hydrogen gas when exposed to moisture.

- Expended pyrotechnic/practice devices may contain red/white phosphorus residue. Due to incomplete combustion, red and white phosphorus may be present and re-ignite spontaneously if subjected to friction, or if the crust is broken.

- Extra care shall be taken when uncovering a buried UXO if a records search indicated white phosphorus (WP) munitions were fired or destroyed in the area. A buried WP munition may be damaged and when exposed to air, may start burning and detonate. An ample supply of water and mud shall be immediately available if excavation reveals a WP UXO. Appropriate protective equipment and first aid shall also be immediately available.

- Do not approach a smoking WP UXO. Burning WP may detonate the burster or dispersal explosive charge at any time.

- Do not transport a WP munition, unless it is immersed in water, mud or wet sand.

- WP UXO shall not be detonated into the ground. The UXO shall be counter-charged on the bottom-center-line.

T.6 SAFETY PRECAUTIONS FOR AIRCRAFT - HAZARDS AND ASSOCIATED MUNITIONS

- Turn off aircraft power prior to working on any munition or hazard, still attached to the aircraft.

- Ensure that the aircraft and all personnel are properly grounded before operations on any ordnance attached to the aircraft.

- Always consider a dispenser to be loaded. The presence or absence of a payload may not be obvious from an external examination.

- Do not remove munitions from a dispenser unless absolutely necessary. Many of the contained munitions are designed to arm as soon as they leave the dispenser.

- Approach and work on unfired rocket and missile motors from the side. Do not expose electrically fired rocket motors within 150 feet of any exposed electronic transmitting equipment or exposed antenna leads.

- When approaching an unidentified guided missile, observe liquid fuel and liquid oxidizer precautions until monitoring has been verified that the missile does not contain these hazards.

- Do not disconnect or cut any electrical cable unless it is specifically prescribed in the EOD procedure.

- Be aware of high voltage, thermal batteries, wet cell battery acid and high pressure lines.

- Always approach an aircraft involved in an accident at a 45 degree angle from the rear.

- Some practice bombs do not contain any positive safety features. Positively identify and review all safety precautions prior to handling practice bombs.

T.7 SAFETY PRECAUTIONS FOR GROUND LAUNCHED AND EMPLOYED MUNITIONS

- All munitions that have been fired, launched, thrown, placed, etc., will be considered armed.
- Permit only one man at a time to work on a mine.
- Consider an emplaced landmine armed until proven otherwise. Many training mines contain firing indicator charges capable of inflicting serious injury.
- Exercise care with wooden mines that have been buried for a long time. Because of soil conditions, the wood deteriorates and the slightest inadvertent pressure on top may initiate the fuze.
- Probe and examine carefully the ground around a mine before starting to work on it.
- Be constantly on the lookout for boobytraps.
- Before lifting a mine, neutralize all fuzes and remove the mine, remotely.
- Always assume a mine to be protected by other mines, anti-lift devises and other boobytraps.
- Do not cut or pull a taut wire, never pull a slack one; look at both ends of a wire before you touch it.

T.8 RENDER SAFE PROCEDURES AND DISPOSAL OF UNEXPLODED ORDNANCE

- The preferred and safest method for disposal of UXO is to destroy it in its original position by detonation. This method should be used whenever considerations and circumstances permit.
- No UXO shall be destroyed until it has been positively identified. Make every effort to identify the UXO. Carefully examine the item for markings and other identifying features such as shape, size, and external markings. However, do not remove the item to inspect it. If an unknown UXO is encountered, photographs shall be taken and express-mailed to CEHND-ED SY (or other governing agency), which has access to the Army Technical Manual (TM) 60 Series publications.
- If the situation dictates, protective measures to reduce shock blast, and fragmentation damage shall be taken. TM 5-855-1, Fundamentals of Protective Design for Conventional Weapons and associated software program "CONWEP" contains data on blast effects, groundshock, cratering, ejecta, and fragmentation.

- Consideration shall be given to tamping the UXO to control fragments, if the situation warrants.

- Coordination with the appropriate airspace representative shall be conducted and the appropriate notification procedures arranged.

- A post-search of the detonation site shall be conducted to assure a complete disposal was accomplished.

- Do not pack a bomb fuze well with explosives, unless it can be positively confirmed that the fuze does not contain any fuze components.

- If a UXO must be transported off site for disposal, the provisions of 49 CFR 100-199, state and local laws shall be followed.

- If base-ejection type projectiles must be transported to a disposal area or collection point, the base shall be oriented in the rear of the vehicle and the projectile secured, in the event the ejection charge functions in route.

- If an UXO with exposed hazardous filler (HE, etc.) has to be moved to a disposal area, the item shall be placed in a heavy duty plastic bag to prevent migration of the hazardous filler. Padding should also be added to protect the exposed filler from heat, shock, and friction.

- Do not undertake the handling or disposal of liquid propellant fuels or oxidizers if not familiar with the characteristics of the material.

- Inert ordnance will not be disposed of or sold for scrap until the internal fillers have been exposed. Heat generated during reclamation operation can cause the inert filler, moisture and air to expand and burst sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to confined pressure.

APPENDIX U USE OF EXPLOSIVES FOR SEISMIC REFRACTION SURVEYS

APPENDIX U USE OF EXPLOSIVES FOR SEISMIC REFRACTION SURVEYS

U.1 INTRODUCTION

This appendix lists some of the more important aspects of the purchase, transport, storage, handling, and use of explosives. it is intended as a general guide for ABB-ES personnel who may be involved in conducting seismic surveys or who may be overseeing or auditing such surveys. It is not intended as a stand-alone reference replacing appropriate federal and/or state regulations, which can be very specific about certain aspects regarding explosives.

Many recent advances in computer software and hardware and hardware technology have revolutionized data processing and interpretating in the seismic industry. Likewise, the recent development of sophisticated (and very expensive) truck-mounted energy sources that can scan a large range of frequencies for optimum response from deep reflecting horizons has made possible reflection surveys for hydrocarbon deposits to depths of up to 20 kilometers. However, for shallow (i.e., the upper several hundred feet) seismic refraction surveys, the best and most economical energy source continues to be small explosive charges detonated with electric blasting caps.

A small explosive charge, as defined herein, consists of the equivalent of from 1/8 to 1 pound of dynamite which is primed for detonation with one or more electric blasting caps. The "dynamite" that ABB-ES generally uses is KINESTIK 1/3, which consists of a powder and liquid, mixed on-site to form an explosive, similar in performance to dynamite. Each stick (86 to a case) is equivalent to 1/3 pound of dynamite. Before mixing, the two parts are not considered by the DOT to he explosive; therefore, they can be shipped, transported, and stored with no special precautions. In practice, ABB-ES personnel shall take every precaution to ensure that the powder and liquid are separated while being stored for any length of time to prevent unauthorized access to potentially explosive materials.

Electric blasting caps come in two configurations acceptable for seismographic work. The "seismograph" variety is best because of its repeatability with regard to delay time (i.e., the time that elapses between when the "fire" button on the blaster is depressed and when the blasting cap actually detonates). The other type is known as "instantaneous," and it has acceptable delay time characteristics. Blasting caps are graded by the federal government (and all states) a Class A explosive and must be handled and stored accordingly. Requirements for Class A explosive are discussed in the following subsection.

U.2 PURCHASE, TRANSPORT, AND STORAGE

The federal government has specific guidelines regarding the purchase, transport, and storage of explosives, particularly regarding interstate commerce. In addition, each state has developed regulations that supersede federal regulations if they are more restrictive. Therefore, the user must become familiar with federal as well as state regulations. In practice, it is unlikely that ABB-ES would ever become involved in interstate activities regarding explosives. In fact, it has been ABB-ES's practice to subcontract out-of-state blasting activities to a local blaster to minimize expenses that would otherwise be incurred in obtaining necessary permits, and to eliminate time expended to

purchase, transport, and store explosives. The following subsections pertain to State of Maine requirements. Other states can be and are different from Maine, and requirements vary widely.

U.2.1 Purchase

In the State of Maine, a blasting license for an individual is not required. Such a license is required in Massachusetts (a competency license) and New York (an explosives license). However, the State of Maine does require a written permit, issued by the Commissioner of Public Safety, for the transport of explosives in intrastate commerce in quantities larger than 200 pounds of dynamite, or more than 500 electric blasting caps. Although ABB-ES never transports quantities exceeding these amounts, it has been company policy to obtain the State Permit to Transport Explosives, because it provides additional credibility to explosives vendors and local officials.

Before purchasing explosives in Maine, the user must obtain a permit from the fire marshal or appropriate local official in the town in which the explosives are to be used and/or stored. The local official must first establish the identity of the applicant, verify that he or she is older than 21 years of age and is a U.S. citizen, and inquire about the intended use of the explosives. Permitting thorough local officials can be as easy as a courtesy telephone call from the official notifying the local fire department or police chief (every town or city handles explosives permitting a little differently).

Before selling explosives, the state requires the vendor to verify that a valid permit has been issued to the buyer by the appropriate local town official. In addition, the vendor should ascertain whether the buyer can comply with the rules and regulations relative to the transport of explosives.

U.2.2 Transport

Before issuing the State Permit to Transport Explosives, officials from the Department of Public Safety in Augusta, Maine, inspect the vehicle driven by the applicant to ensure that it is roadworthy. They also inspect the explosives magazine in which the explosives will be locked while in transit. State regulations require that the magazine be constructed of 1-and-1/2-inch-thick planking with no exposed metal on the inside (to eliminate sparks) and sheathed with NO. 24-gauge galvanized sheet steel. The magazine should have a strong hasp and padlock and be locked at all times when explosives are being transported. The magazine should also be chained and locked within the vehicle to prevent removal or shifting while under way. In addition, the vehicle should be equipped front and rear with two 1-quart (minimum) fire extinguishers suitable to extinguish electrical fires, and four diamond-shaped Class "A" explosives signs mounted on the front and rear and both sides of the vehicle. ABB-ES owns a "day" magazine and other equipment that meets these requirements.

U.2.3 Storage

Regulations are very specific regarding storage. All that ABB-ES personnel need to remember is Class "A" explosives must be returned for storage to a permanent or temporary magazine before sunset on each day of usage. The ABB-ES day magazine is not a permanent or temporary magazine. A permanent magazine is a substantial structure located well away from dwellings and buildings where people work or

congregate. It has walls 4 to 8 inches thick (depending on method of construction), strong doors with interior hinges, and double-shielded locks specially designed for storage magazines. The roof is constructed to be bullet-proof, and foundation requirements are also specified. A temporary magazine is usually a rather massive steel box (i.e., 350 to 500 pounds or more) on casters, lined with thick wood planking, with double-shielded locks. It should be securely fastened to the ground.

U.3 HANDLING AND USE

Safety shall be the foremost consideration whenever explosives are being used. Seismic surveys routinely expend 20 to 30 sticks of dynamite (and an equal number of electric blasting caps) during a single field day. To mix the KINESTIK, mix one "tube" of the KINESTICK liquid (a clear red liquid composed of nitromethane) with one "stick" of white powder (ammonium nitrate), and allow to stand until the powder is thoroughly saturated with the liquid (it becomes pink); this takes 5 to 10 minutes. If the upper 4 feet of overburden are wet or saturated, it is a good idea to seal the stick (equipped with a screw cap) with tape to prevent contamination by groundwater. If groundwater enters the stick, it can cause the KINESTIK to misfire.

While the KINESTIK is being mixed, a series of shotholes (usually five) are prepared by driving a pointed 1-and-3/4-inch steel bar to the desired depth (from 2 to 4 or 5 feet) with a sledgehammer. The shothole depth depends on soil conditions and the anticipated size of the charge. Only when the explosives are ready to be placed at the bottom of a shothole, a blasting cap is placed in a molded cavity at the base of each stick. The blasting cap has two lead wires, usually 8 or 12 feet long, which are grounded together with a removable metal shield that should be left in place until the primed shot is ready to be fired. This prevents the induction of electric charge, which could accidentally fire the cap. The lead wires are used to connect the blasting cap to a double conductor (i.e., "shot") wire leading to the blaster. The cap is secured to the KINESTIK by two or more half-hitches with the two cap lead wires.

The explosive is not "primed" for detonation. After the primed shot is placed at the bottom of the shothole, a small amount of native soil (preferably sand) is placed in the hole and gently tamped with a tamping stick into the base of the hole over the primed explosive charge. A proper tamping stick is wooden (non-sparking), about 6 feet long and 1 to 1-1/4 inches in diameter (Note: dowel stock works well). The tamping procedure continues until a uniform column of native soil completely fills the shothole. One should be careful not to damage the cap lead wires during the tamping process.

The removal metal shield grounding the two cap lead wires together is removed only when the shot is ready to fire. Prior to making the connection between the cap lead wire and the shot wire leading to the blaster, the person making the connection should ascertain that the shot wire has been sorted out as the blaster by the party chief (operating the blaster) so that inadvertent detonation is not possible). While making the connection, the lead wires should be extended as far from the shothole as possible. The person making the connection shall turn his or her back to the shothole, remove the metal grounding shield, and attach the shot wire leads (no polarity) to the cap wire leads.

As each shot is detonated, one person (usually the one making the connection) will be assigned to verify that no one is near the shot. The party chief shall then call out, "Are you clear (of the shot)?" The response, "all clear" indicates that everything is ready and no one is close enough to be in any danger when the shot is detonated. A "safe" distance varies with soil conditions and the depth of the shot; 75 to 100 feet is generally adequate. The party chief then calls out to everyone in the area, "Fire in the hole," and the charge is detonated.

If a misfire occurs (extremely rare), it is the responsibility of the party chief to remove the undetonated charge from the ground with a nonsparking shovel of wood or brass. The party chief is responsible for maintaining an explosives log that documents all explosives purchased, expended, stored, and destroyed. This log is subject to inspection at any time by local, state, and federal officials. It provides a record detailing the disposition of every cap and stick of dynamite (or KINESTIK) that comes under the control of ABB-ES personnel.

The amount of explosives that can be loaded into a shothole depends on the nature of the surface materials and the depth of the water table. Some general rules follow:

- use as few explosives as necessary to produce good quality data
- the more granular the soils, the more explosives will be required (to produce good data); the finer the soils, the fewer will be required
- the deeper the water table, the more explosives required, and vice versa
- the deeper the bedrock, the more explosives will be required, and vice versa

When ascertaining the proper explosive charge to produce good data at a new site, it is good practice to start with a single shothole well away from any buildings and power lines, and perform a test shot to determine local soil (an energy transmission) characteristics. Start with a small charge (e.g., half a stock of KINESTIK, obtained by mixing half the liquid from one tube with half the powder form one stick) buried to moderate depth (e.g., 3 feet) and increase (or decrease) the amount of the charge (and the depth of the shothole) as necessary.

U.4 EXPLOSIVE USE AT NTC, ORLANDO

If seismic refraction surveys utilizing explosives are conducted at NTC, Orlando, the purchase, storage, transportation, and handling of explosives will be subcontracted to a Florida licensed professional blaster. The blaster will be responsible for the safe handling, storage, and use of explosives in accordance with federal, state, and local regulations.